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THE GEOGRAPHICAL JOURNAL

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The
GEOGRAPHICAL JOURNAL

Vol LXXIII No 4 R.G.S. *April 1929*

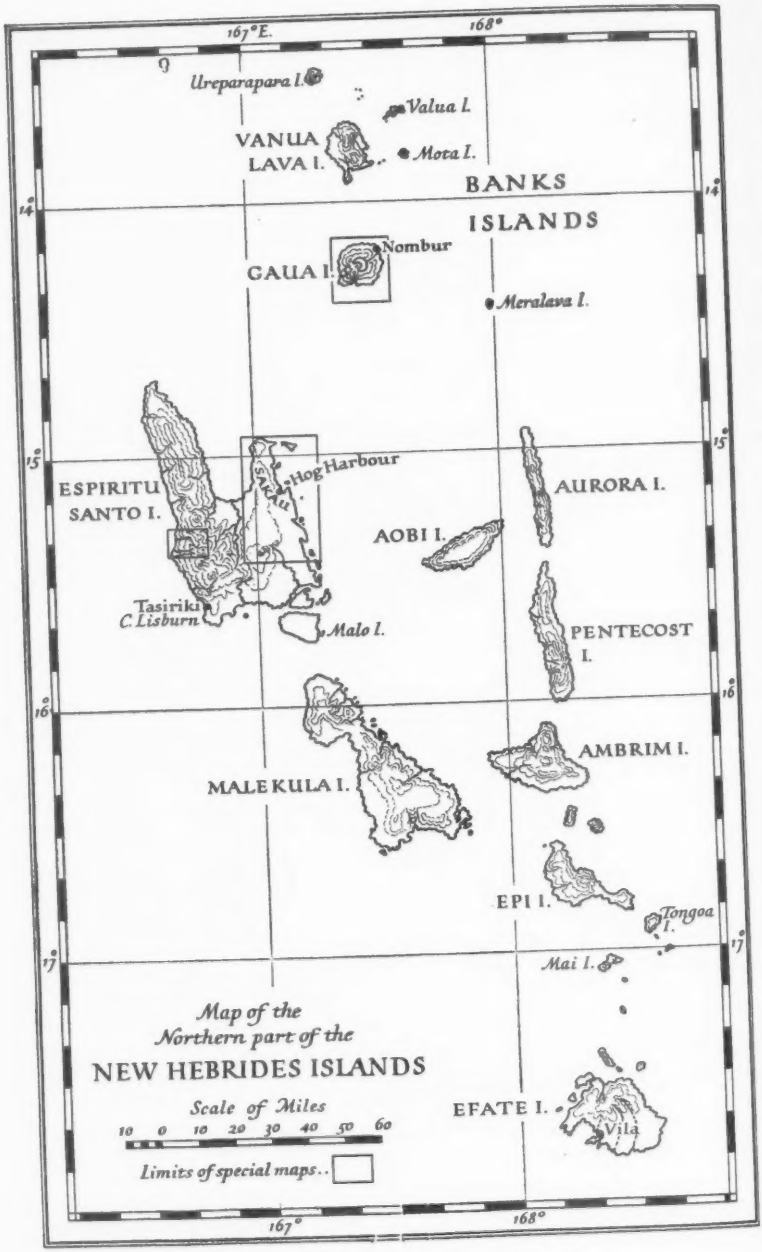
THE NORTHERN NEW HEBRIDES: *A paper read at the Evening Meeting of the Society on 21 January 1929, by*

JOHN R. BAKER, M.A., D.PHIL.

MY main objects in visiting the New Hebrides in 1922–3 and again in 1927 were biological and anthropological, and I propose to give a short account of my investigations in these fields in this paper. I shall also describe what geographical work I was able to do, but I must acknowledge that I am ill-equipped as a geographer on account of my ignorance of surveying. I brought a surveyor with me on my second visit, but unfortunately he got tired of the expedition and left me before much was accomplished. My brother and the draughtsmen of this Society have prepared maps from my rough surveys, but too much confidence must not be placed in their accuracy, since they are based only on compass traverses, distances being measured by odometer or time on the march and altitudes by aneroid barometer.

I have very great pleasure in acknowledging my indebtedness to the Trustees of the Percy Sladen Memorial Fund and to my mother and brother, who supported the expeditions financially. My brother helped also in many other ways, but particularly by drawing maps from my rough notes. Professor T. T. Barnard was my companion on my first visit. On my second I was alone during part of the time, but was joined towards the end by my wife and Mr. John Morel. It was after their arrival that the most important objects of the expedition were achieved. Among my many helpers I must mention Mr. and Mrs. W. Anderson, the Rev. R. E. Tempest, and Mr. T. O. Thomas. Altogether I spent a little over a year in the New Hebrides.

The New Hebrides are in the Western Pacific Ocean, about 1500 miles from Australia: south of the Solomons, east of New Caledonia, and west of Fiji. They extend from 13° to 21° south of the equator, and have a tropical climate with heavy rainfall (about 120 inches in the year in Espiritu Santo). In the northern islands no part of the year can be described as a dry season. A thick rain-forest covers nearly the whole of all the northern islands from high-tide mark to the summits of the highest mountains. The chief economic productions are copra, coffee, cotton, and cocoa. There are rather over a thousand whites, mostly French, scattered round the coasts. About four hundred of them live at Vila, on Efate Island, which is the seat of government. Nowhere else is there anything that could be called a white settlement.


167°E.
168°
Ureparapara I.
Valua I.
VANUA LAVA I.
Mota I.
BANKS ISLANDS
14°
Nombur
GAUA I.
Meralava I.
15°
ESPIRITU SANTO I.
Hog Harbour
SARAMA
AURORA I.
AOBI I.
Tasiriki
C. Lisburn
Malo I.
PENTECOST I.
16°
AMBRIM I.
MALEKULA I.
EPI I.
Tongoa I.
17°
Mai I.
Map of the Northern part of the
NEW HEBRIDES ISLANDS
Scale of Miles
10 0 10 20 30 40 50 60
Limits of special maps..
EFATE I.
Vila
167°
168°

The islands constitute a Condominium, belonging equally to Great Britain and France. The whole administration is in duplicate. I saw an ugly incident in Vila harbour one day which shook any faith I might have had in this unsatisfactory form of government. As the boat which was carrying me steamed into the harbour, I noticed a ship's lighter filled to overflowing with about a hundred Tongkinese indentured labourers. Nearly all were standing, simply because there was no room to sit. As these unfortunate people were simply left motionless under the tropical sun, I inquired why nothing was done about them. I was informed that they were not allowed to land on account of some of them having mumps, and that they had been in the lighter for *several days!* I went at once to the British Resident Commissioner to ask that something should be done at once, but was informed that as they were indentured by Frenchmen he could do nothing for them, and that complaints from Britons would be ignored by the French administration.

The chief missions are the Presbyterian and the Church of England. I always received the greatest kindness from the missionaries, who did everything they could to help me in my researches. The Presbyterian missionaries do a considerable amount of medical work, and there is no doubt that the injections of Neokharsivan which they give in treatment of the terribly prevalent disease of yaws are highly beneficial. It is easy to speak disparagingly of missionaries, but there is no doubt that those in the New Hebrides have the welfare of the natives very much at heart. It is amusing to compare the opinions of the several Missions in the matter of intoxicants. The Seventh Day Adventists will not allow their adherents to take tea or coffee, far less alcohol. A Roman Catholic Missionary, on the contrary, told me how to make artificial absinthe from rum mixed with a paregoric medicine!

Most of my time was spent under canvas in the islands of Espiritu Santo and Gaua, particularly in the north-eastern peninsula of the former island, which is called Sakau. The following remarks on the natives refer chiefly to the heathen of Sakau. They are Melanesians, a very dark brown primitive race, with thick lips and curly black hair. The men of Sakau wear a belt round the waist, from which depends in front a short strip of calico and behind a bunch of leaves. They live almost precisely the life that their ancestors have lived for centuries. In the whole of Sakau there are only seven whites, and these have no influence on the inhabitants of the interior. With the exception of diseases, the only European influences in the interior are the calico strip, the knife, and the muzzle-loading musket, without which no heathen native ever leaves his village. The people are cheerful and remarkably honest. Although tinned meats and tobacco are very highly prized, I never lost a single tin of meat nor a single stick of tobacco, though my tent was often unwatched for days on end.

The chief interest of the people is pigs. Pigs are the chief form of property; they are the money with which a man buys a wife from her father; they are the means whereby a man rises in rank. There are five ranks in Sakau society, and a man rises from one to the next by making a great night-long dance at which he kills a stipulated number of male and intersexual pigs. I have witnessed one of these dances, which are seldom seen by whites, and can testify to the wild abandon with which it was carried through. The sight of a couple of

hundred savages dancing madly round a huge bonfire in a clearing in the dense forest at midnight is one which will always remain in my memory.

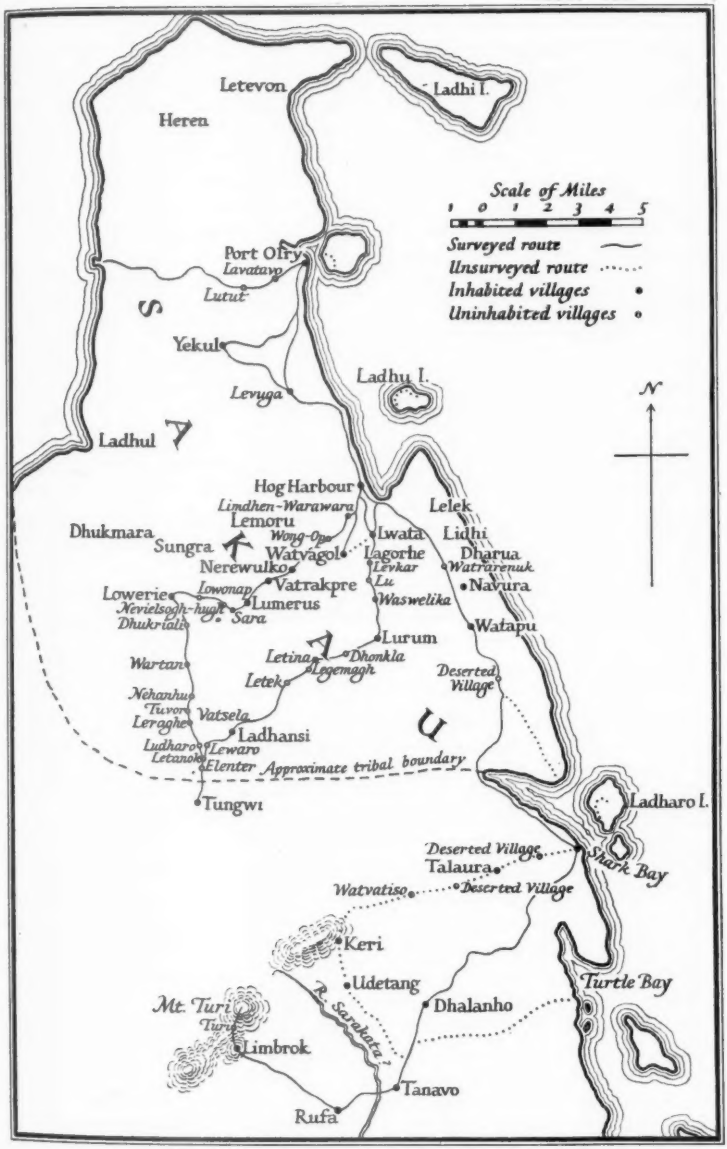
Cannibalism still occurs, though rarely. To my mind this is not so terrible a vice as it is usually considered, for they do not kill people in order to eat them, but only eat them when they have been killed for other reasons. Between my two visits a white man was killed in the south-west of Espiritu Santo, and the flesh of his legs divided between several villages and eaten.

There are always vendettas, and innocent people are often killed to avenge the death of some one else. On one occasion there was a rather serious outbreak of fighting in the interior of Espiritu Santo. A young chief was terrorizing the neighbourhood from his village on a mountain. Mr. W. Anderson, the Presbyterian missionary of eastern Espiritu Santo, decided to go inland to investigate, and Prof. T. T. Barnard and I accompanied him. We spent several days going round the oppressed villages, and took a chief from each to a conference in the oppressor's village on the mountain. We had sent a messenger ahead to give notice of our intention, and there was no disorder when we arrived with the long file of the oppressed. A conference began, and I thought it would never end. The people talked interminably, one after the other. Mr. Anderson addressed them through an interpreter. At last, to our great surprise, we were informed that a wholly satisfactory agreement had been made. The chief oppressor was to give a pig to the chief of the oppressed, and the chief of the oppressed was to give a pig in return! Such is the importance attached to the reciprocal gift of a pig.

The languages of the New Hebrides are innumerable. The little island of Gaua, only 12 miles across, has two quite distinct languages. The traveller would be in very great difficulties if there were not a veritable Esperanto of the islands in the form of pidgin-English. This most amusing language is based mainly on English words, but the construction is very peculiar; also the small vocabulary makes it necessary to talk very much round the point if one is to convey a difficult concept. All natives who work on plantations learn it, and one can always find people who can speak it in the coastal villages. Interpreters are therefore always at hand.

The women of Sakau go naked except for a fine thread which passes round the body above the hips and supports a thin strip of leaf, which passes between the legs and is held in position by the insides of the legs. The people are polygamous, but, as in all polygamous countries, only a few of the men have more than one wife. The enormous numerical preponderance of males makes much polygamy impossible, though a great chief named Dhingaru had five wives at the time of my visit. On the death of a chief there is a tendency for the widow or widows to commit suicide. A case occurred in Sakau just after my second visit. Apparently the custom is for the widow to rush up and down until absolutely exhausted, and then to hang herself or allow others to hang her.

The children's hair is often bleached with lime, which is applied for the purpose of killing the lice which infest it. An anthropologist whose theories demanded a fair-haired ancestor for the race was delighted when he landed at Hog Harbour in Sakau one day and saw a blond child, a living verification of his guesses. He at once photographed it and reproduced the photograph



Map of the North Eastern Part of
ESPIRITU SANTO ISLAND.

in a great work in two volumes. It is a pity that no one told him that lice, and not a fair-haired ancestor, were the cause of this condition.

The native houses are small, and built about a ridge-pole like a tent. The roof comes nearly to the ground on each side, and there is nothing that can be called a side wall. The only aperture is the door at one end, which is filled when required by a number of loose bamboos. At a village in the interior called Tungwi, which had not previously been visited by a white man, I found what must be some of the smallest human habitations in the world. The tops of all the houses except the men's club-house only come as high as my shoulder. Inside one could only crawl about.

Handicrafts are very primitive. Some arrows from Gaua show better workmanship than any other implement which I saw. These consist of a shaft of reed, to which is lashed in front a short length of tree-fern wood. The actual point is usually of human bone, and the binding of this to the tree-fern wood is very complicated. It is said to be so arranged that the bone breaks off and is left inside the victim's body. The arrows never have feathers to steady their flight.

It is remarkable that no pots or pans are made in any part of the group except in a tiny area on the west coast of Espiritu Santo, where simple pottery is fashioned. Elsewhere nothing can be boiled or stewed; all cooking consists in baking by placing the food among previously heated stones.

Fauna.—The fauna is a typical one for a group of islands which has never been near a continent. As is usual in these cases, the only endemic land mammals are bats and rats. Five species of fruit-bats occur, of which one belongs to the remarkable tailed genus Notopteris. Three of the fruit-bats are peculiar to the islands. The only other land mammals are two insectivorous bats and a species of rat which is widely distributed in the Pacific.

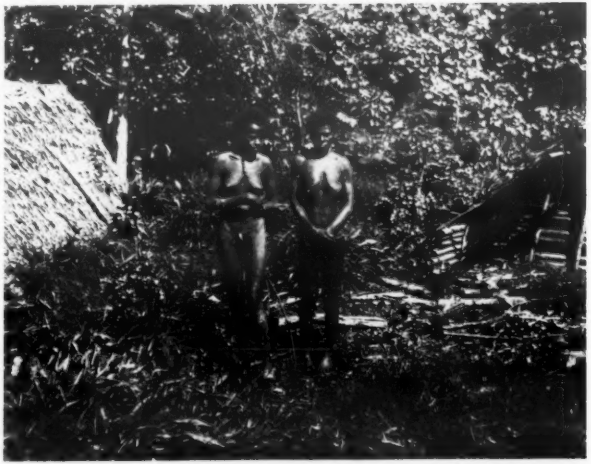
Fifty-three species of non-marine birds have been recorded, of which no fewer than thirty-seven are confined to the islands. On the whole the bird fauna is Australian, including such characteristically Australian groups as the Megapodes, Brush-tongued parrots, Wood-swallows and Honey-eaters. Two genera occur, however, which are absent from Australia. These are Turdus (Thrushes) and Erythrura (Weaver-birds). It is very remarkable that these birds should have spread down through the Malay archipelago and New Guinea to the New Hebrides, and yet have missed Australia completely.

Fourteen Geckos and Skinks occur, but only two species of snakes. These are quite harmless, belonging, curiously enough, to a non-poisonous subfamily which is essentially American and of which no representatives occur in Australia. As nearly always on oceanic islands, there are no Amphibia. The fresh-water fishes belong to groups which can live also in the sea. Among invertebrates the most important species economically is *Anopheles punctulatus*, the mosquito which carries malaria. This disease is terribly prevalent among both whites and natives. Unfortunately the mosquito seems to breed in small puddles, especially where the fresh water seeps out of the porous rocks near the seashore. It seems unlikely that it will ever be possible to deal with it in such situations as these, the paraffin method being inapplicable.

The most interesting animal to me is the intersexual pig. The pigs of the

Steaming Hill Lake and Mount Gharat, Gaua Island

A leper and his hut, Sakau



Women of Sakau

West Coast of Espiritu Santo

Port Patteson, Vanua Lava

Men of Sakau

New Hebrides were probably brought there by the natives when first they came to them. The extraordinary thing about them is that a large number are intersexual. In Europe one may obtain a specimen at very long intervals from a bacon factory which kills a thousand pigs a week and is on the look-out for them. In certain islands of the northern New Hebrides they abound, and the natives attach particular value to them (though they are quite useless in a practical sense, since their flesh is not eaten). Nowhere else in the world are they so abundant: I once saw 125 in a single day at Hog Harbour. Their value arises from the fact that a man can only rise in rank by killing a certain number of them at the night-long dance mentioned before.

Steaming Hill Lake

In his great work 'The Melanesians,' Dr. R. H. Codrington says (p. 17): "The Tas in the middle of Santa Maria [Gaua] in the Banks Islands is the only lake of considerable size in Melanesia. It is about 5 miles long, occupying the hollow of an ancient crater, into which the steaming hill Garat has been intruded; the waters pour out in a magnificent waterfall . . . the Tas of Santa Maria will surely reward its first scientific visitor." It has been my fortune to be its first scientific visitor.

Sir Douglas Mawson mentions the lake in his paper on the geology of the New Hebrides (*Proc. Linn. Soc. N.S.W.*, vol. 30), but evidently he did not visit it. Several missionaries and Mr. G. R. Salisbury have seen the lake, but there has not previously been an adequate map of it. In the Admiralty Chart and the map of the French *Ministère des Colonies* it is represented (obviously from report only) in quite the wrong position, of quite the wrong shape, and far too small.

During my first visit to the New Hebrides I was brought to the island of Gaua on the steam yacht *Southern Cross* by courtesy of the Melanesian Mission. I made two expeditions to the lake, the first in company with the Rev. R. E. Tempest and Prof. T. T. Barnard. Both these visits were for an hour or so only, as we had not facilities for camping there; further, we had not sufficient instruments for a proper scientific study of the lake nor a boat in which to explore it. Nevertheless, the few animals I took in a hand-net encouraged the belief that the fauna would be interesting. The isolation of this great lake from any other large expanse of fresh water could hardly have failed to cause it to be tenanted by an interesting group of creatures. What animals could have found their way there? How have they become modified as a result of their isolation? I was determined to find out on my second visit to the islands.

This time I lacked nothing. In addition to camping outfit I had a collapsible boat, boulting-silk hand-nets, large and small plankton-nets, a dredge, fishing-tackle, pipettes, enamelled basins, jars and tubes for specimens, alcohol, formalin, apparatus for determining the degree of alkalinity or acidity of the water, a water-sample bottle, a light sounding-apparatus specially made by my brother, an ordinary thermometer, a minimum thermometer, a reversing thermometer to take temperatures at all depths in the lake, a prismatic compass, and an aneroid barometer.

It seemed at first that my excellent equipment was going to be wasted owing

to my inability to get to the island of Gaua at all, for the inter-island steamer does not call there and the *Southern Cross* was not in the group. I asked the representatives of Messrs. Burns Philp & Co. (the steamship owners) at Vila to get their boat to stop at Gaua to put me down there on its way from Vila to the Santa Cruz group, north of the New Hebrides. They were most agreeable, but said that the Government would never allow it, since the boat was "cleared" by the Customs at Vila and was not allowed to call anywhere until it entered the Santa Cruz group. Undismayed, I called upon the British Resident Commissioner, who said he would give the necessary leave if the French Resident Commissioner would do the same. The French Resident Commissioner was equally obliging, and everything seemed hopeful. Messrs. Burns Philp gave instructions that their boat should go about 20 miles out of its course and put us down on the north-east coast of Gaua.

Our luck was out. As we neared Gaua an easterly swell became reinforced by a strongish wind from the same direction, making it very dangerous for the steamer to heave to in the open sea and put us ashore in whale-boats. To add to the difficulty, the tide was low and the reef dried off. In the circumstances the captain was undoubtedly right in refusing to put us ashore, and we were carried right out of the New Hebrides into the Santa Cruz group. I shall not forget my feelings when I saw the village that had been my home four and a half years before, and which was to be my base for the exploration of the lake, and was carried on past it to a part of the world to which I had no anxiety to go.

When we got back to the New Hebrides, we pitched our tent once more at Hog Harbour and hoped that some means of getting to Gaua would turn up unexpectedly. A planter called in at Hog Harbour in his cutter one day, and we besought him to take us to Gaua. He told us he was going south, but would call back in a day or two to bring us there. We made lists and packed everything up in readiness, and then started to wait, never going more than a few hundred yards away lest the planter should return and go away without us. We waited in this way for nearly a fortnight, every day seeming more exasperating than the last. At last he came—but refused to take us.

Months later our chance came. The inter-island boat came in to Hog Harbour. She was bound for Vanua Lava, an island to the north of Gaua. We felt that if we could get to Vanua Lava we could somehow manage to get from there to Gaua. The main difficulty now was how to get away from Gaua. Here Mr. T. O. Thomas came to the rescue, by most generously guaranteeing to send his cutter for us if we had not returned by some other means by a certain day.

Our party consisted of my wife, Mr. J. de H. Morel, and myself. On arrival at Vanua Lava we got a Japanese Trochus-fisher to agree to take us to Gaua in his little cutter. The distance to be covered was only about 25 miles, so we started off quite light-heartedly a little after 9.30 a.m. despite the roughness of the water out to sea. When we got outside the protection of the land and headed southwards, we were dismayed to find that our little oil engine could do nothing with the sea and wind against us. For an hour we actually moved backwards, and the Japanese pressed us to allow him to return. But at last a slight change in the direction of the wind enabled us to progress, and later

we were able to hoist our sails and make tacks into the wind. The sea was mountainous. One moment we were on the crest of a great wave, and Vanua Lava was clearly visible aft and Gaua forward; the next we were down in the trough with nothing visible but angry water on every hand. We were a miserable human cargo on the tiny deck of the little craft, a mass of limp, prostrate black and white bodies holding on as tight as sea-sickness would allow. At the end of each great tack we seemed as far from our objective as we had been at the end of the one before, and I began to think that we should have to give in to the inscrutable little Japanese, who left his engine now and then and scrambled forward to ask if he should turn and run back before the wind to Vanua Lava. It was seven o'clock, and of course dark, when we experienced the indescribable relief of passing in a few moments from the rough sea through the breach in the coral reef at Losolav, on the north coast of Gaua, into the dead calm of the water within.

We slept on board, and next day put all our belongings into two dinghies belonging to the Japanese and rowed round the coast inside the reef to Nombur. There was no white person on the island, but we were most hospitably received by my old friends the people of Nombur, with whom I had stayed nearly five years before. My wife was a great source of interest, and the women insisted on feeling her all over so as to be certain of her sex.

I had been worried for some time with the thought that I would not be able to get porters to carry all our gear to the lake. There is no village near the lake, so nearly everything we were to eat had to be carried. In addition there was, of course, the collapsible boat, our camping gear, and the scientific apparatus. I hit upon the following plan to get the people to carry for us. I told one or two of the chief people that I would like to address every one in the village after sundown; but I did not tell them on what subject I proposed to speak. I wished to catch them unawares and appeal to their herd-instinct at a time of day at which people are very susceptible to suggestion. If I had at once begun to ask them to act as porters the news would get about and many would begin to invent excuses for refusing.

Soon after it was dark the people assembled, the men in one group and the women in another. I stood between them in the light of our lantern and made a speech in pidgin-English which was interpreted, sentence by sentence, by a man who stood beside me. I looked round to judge the effect of my appeal. I could gather nothing from their faces in the lamplight. A few murmured remarks, a few glances, and the decision was made. I looked to my interpreter, fearing the worst. Every one, man, woman and child, would come to carry my things to the lake! I had suffered so much from delay in the islands that I had little hope when I asked when they would be prepared to start. Another mute referendum was taken, and to my joy the interpreter announced that they would bring us and all our baggage to the lake the next morning. My ruse had worked indeed! The total population of Nombur is thirty-one. With a few recruits from a neighbouring village, we had nearly thirty porters.

Next morning (31 May 1927) we started off at about 9.30, every one, including ourselves, being laden. The women who had babies carried them, so they could not be described as very efficient porters from my point of view; but it was a great day for them, as they had never seen the lake before. Our

guides were determined to show us off to the other natives of the island as much as possible, so they brought us a very roundabout route, passing by several villages, and we did not arrive at the lake until nearly two o'clock. On my first visit we had walked there in two and three-quarter hours.

We descended to the shore and found a few upright posts indicating where a native house had been before. Our carriers set to work to build on these foundations. They made us a splendid shelter thatched with wild banana leaves in a surprisingly short time. We threw our light-weight tent over it and secured it with ropes, and thus always had a dry retreat despite the heavy rain.

We made an arrangement with our carriers that they should return on the seventh day to bring us back. After they had gone, we felt it rather strange that we were quite at their mercy. If they did not return on the agreed day we should not be able to live at the lake for more than a few days on account of lack of food; nor could we find our way back to the coast. White people cannot find their way among the maze-like native paths, even when provided with a compass. One scarcely ever gets a view of the surrounding country, owing to the thick forest which hems one in on every side. We therefore put aside some of our store of food, and divided the rest into rations for the seven days. My wife, who was in charge of the camp arrangements and also helped with the geographical and zoological work, is the only white woman who has seen the lake.

The sketch-map represents the island of Gaua. The lake, the surrounding hills, and the track from Nombur and back are from my own observations. We measured a base nearly three-quarters of a mile long along the shore of the lake northwards from near the outflow of the river Lusal, and mapped the lake and surrounding hills by bearings from the ends of this line. The course of the Lusal is from native report only. The remainder of the island is from the Admiralty Chart. The form-lines, which are 100 feet apart, are continuous where due to my observations and broken where sketched from the Admiralty Chart. The map was drawn from this material by my brother, Mr. S. J. Baker, and redrawn for publication by the draughtsmen of the Society.

The lake is about 1100 feet above sea-level. There seems to be little doubt that the basin of the lake with its surrounding hills is the crater of an immense extinct volcano. Mount Gharat is a secondary cone, its southern slopes being now in the solfatara stage, with steam and probably other gases ascending from them. The lake has, curiously enough, no native name. They refer to it as *tas*, which simply means "sea." Since it is inconvenient for it to be anonymous, I propose that it shall be called Steaming Hill Lake, from the steaming hill, Mount Gharat.

The panorama, taken by Mr. Morel from the top of a large tree near our camp on the eastern shore, is a reduction from four photographs pasted side by side. Mount Gharat is plainly seen. Dense forest extends everywhere to the water's edge, the steaming southern slopes of Mount Gharat being alone free from vegetation. Just outside the areas from which steam ascends, the vegetation consists of a low scrub and tree-ferns.

The sky was overcast and the temperature remarkably cool and unvarying

Steaming Hill Lake, Gaua

One of the Sladen boiling springs, Gaua

Mt. Tabwemasana from Tatarii, Espiritu Santo

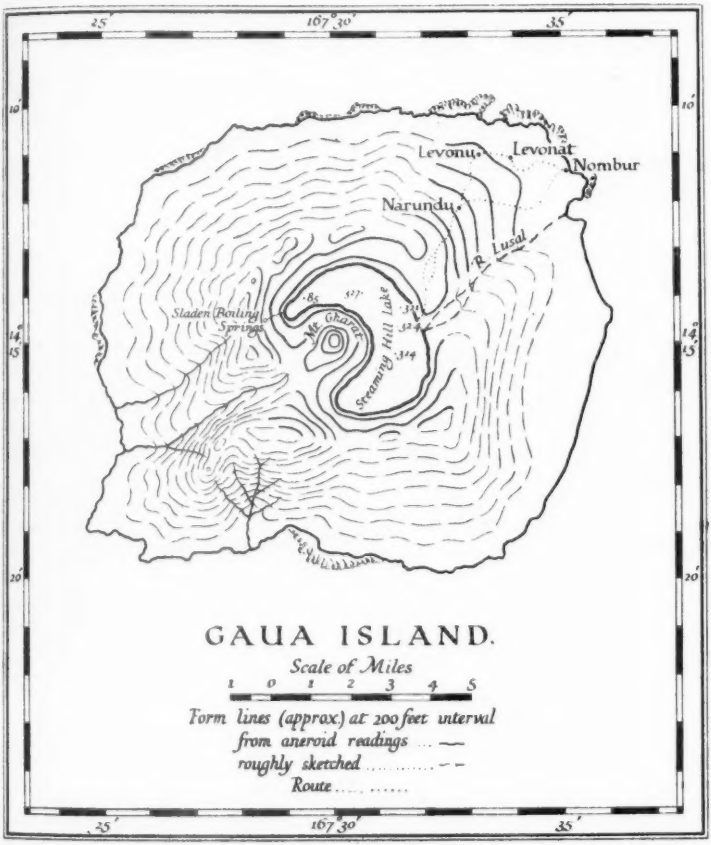
Grassland at 3000 feet on route to Tabwemasana

The Pualapa valley from near summit of Mt. Tabwemasana

Mount Arusasari, Espiritu Santo

during almost the whole of our week's stay by the lake. On June 5 I recorded an air temperature of 22·5° C. (72·5° F.) at dawn, and only 23·1° C. (73·6° F.) at one o'clock. This grey, almost dismal, deserted lake had an eerie fascination for all three of us.

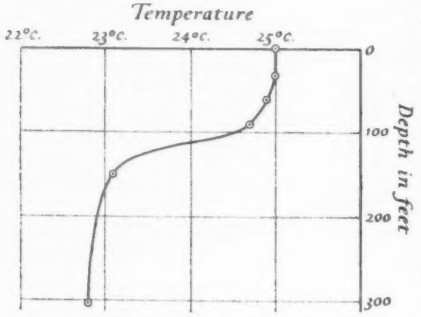
We explored the lake by means of a Ford collapsible boat holding two persons. The figures on the map give the depth in feet. The excellent light



sounding apparatus made by my brother is probably accurate to within a few feet. It will be noticed that four of the soundings are almost exactly the same, and that the lake is far deeper than any in England or Wales. It is evidently flat-bottomed, at a depth of approximately 325 feet. By a series of six soundings at various distances between the sounding in 321 feet and the shore, I was able to show that the bottom slopes almost uniformly to this depth. Taking this fact into consideration, my brother was able to calculate the

mean depth as 200 feet and the volume as 230,000 million cubic feet. The area as 6·6 square miles.

The temperature of the water at the surface in the middle of the lake was always close to 25° C. (77° F.) during our visit, though rather hotter, 25·6° C. (78·1° F.), in the north-west basin, where the stream from the boiling springs (to be mentioned later) flows in, and much hotter, 32·7° C. (90·9° F.), in patches near Mount Gharat. The subsoil of Mount Gharat where we landed on it was uncomfortably hot to the fingers. I took a series of observations of the temperature of the water at various depths down to 303 feet in the middle of the lake by a reversing thermometer, and found that there is not a uniform decrease in temperature with depth. This is shown graphically in Fig. 1. A body of water about 100 feet thick at about 25° C. rests upon about 200 feet of water at about 23° C., with a very small thickness of water at intermediate temperatures. The points on the graph are dependable, the temperature at each depth having been taken twice. In only one case was there a discrepancy of more than 0·1° C. between the two readings at the same depth.



1. *Temperature gradient in Steaming Hill Lake*

The water is alkaline (*p*H. 8·5) and perfectly fresh. There is no truth in the statement made in 'A Dictionary of the Language of Mota'* that the lake is called "tas" (=sea, salt water) because it is brackish. Dr. A. Voelcker, who has analysed my sample, finds that the total solids are only 0·449 gram per litre. In sea-water there are about 30 grams of salts per litre. The salts are mainly those of calcium and magnesium, present probably as carbonates and sulphates, together with some sodium chloride. There is little potash, and nitrates are not present in any determinable amount (though presumably they would have been if my sample had been larger).

On the surrounding hills, to the north and again to the south of Mount Gharat, we saw masses of steam ascending vertically from time to time. We had not time to find both these eruptive regions, but my wife and I sculled in the collapsible boat to the north-west end of the lake to explore the more northerly one. The ascending steam, which was clearly visible at a distance of 4 miles, was now invisible owing to the dense forest which everywhere surrounded us; nor would the thick undergrowth allow us to follow up the hot stream to its source. We were beginning to think that we should never find our objective, when we were startled by an ejaculation behind us. A native had appeared, far more bewildered to see us than we to see him, though we had understood that no native lived within the crater.

Pidgin-English was, alas! of no avail, and I had to fall back upon gesture to

*By R. H. Codrington and J. Palmer (S.P.C.K., 1896), p. 204.

explain that we wanted to be shown the source of the steam. I thought he had grasped the idea, for he led us off at a great pace up the side of the crater. At last he stopped at a shelter which he had made for himself, and we could not induce him to go on. He had supposed that we wanted to see where he lived! More pantomime resulted in his starting off again, and we followed closely, only to be disappointed when he came to a standstill at another wretched little shelter. The human body is scarcely adapted to a very precise representation of a geyser, but now I did my best. Crouching down to the ground, I suddenly sprang to my full height and extended my arms above my head (my topi unfortunately flying off into the hot stream), making a violent sizzling noise at the same time. He had grasped my meaning at last, and before long we were on the spot.

About half a dozen boiling springs are close together on the hillside within the crater which surrounds the lake. I hesitate to describe these as geysers, although the great outbursts of steam seem to be periodic, for during the short time we were able to stay there no water was thrown far into the air. Each consists of a concavity in the hillside, the largest perhaps 60 feet in diameter, with a pool of vigorously boiling water at the bottom, from which a cloud of condensing water-vapour ascends. The Rev. S. Ella is said by Sir Douglas Mawson to have seen a boiling spring on Gaua, and mention of hot pools and boiling mud is made by Codrington.* I do not know whether these are the springs in question. With the permission of the Trustees of the Percy Sladen Memorial Fund, I suggest for them the name of the Sladen Boiling Springs. Near the springs our guide showed us a deposit of what proved on anaylsis to be red ochre.

A small stream flows from the boiling springs to the lake, having a temperature of about 32° C. (90° F.) halfway from its source. This waters the taro-garden of our guide, who is the only man living within the great crater. He ekes out his lonely living by placing his taro in the springs and thus boiling them.

The exit for the water from the lake is by the river Lusal, which leaves its eastern shore in two streams some 20 yards apart, but not joining (according to native report) for a considerable distance. I suppose the Lusal to be the same river as that which flows into the large bay about a mile south of Nombur. There is a large waterfall on its course, which can be seen from the sea. Disregarding a few rocks near the outflow of the Lusal, there is only one island in the lake, close to the shore near its north-western end. It is about 30 yards in diameter.

The most obvious animals of the lake are a duck, a large eel, some dragonflies, a large prawn, and a sponge. The presence of the duck, *Nyroca australis*, and the eel, *Anguilla megastoma*, is not hard to account for, for the duck has wings and the eel has a larva which lives in the sea. The largest eel we secured in the lake itself was 38 inches (97 cm.) long and stout in proportion. The fresh-water prawn belongs to an essentially marine family, and seems to have no difficulty in getting from island to island. It is delicious to eat. The fresh-water sponge is an encrusting species of a green colour, which grows on rocks not far from the shore and is so abundant as almost to give the appearance of

*Codrington, R. H., 'The Melanesians' (Clarendon Press). p. 13.

a coral reef. It seems very probable that the ancestors of this sponge first came to the lake in the form of gemmules in mud sticking to the feet of migrating ducks.

With the exception of a coot-like bird of which we did not obtain a specimen, all the remaining animals in the lake are small. The natives assured us that no fish occurs in the lake except the eel, and certainly we never saw one. Probably the waterfall on the Lusal is the obstacle which prevents the various fishes (other than eels) which can live equally well in salt or fresh water, from getting to the lake.

As I had anticipated, many of the animals in the lake have evolved into slightly different forms as a result of their isolation. About a third of the species of which I obtained specimens are new varieties or new species. It is very interesting that this body of water should contain so many varieties and species which occur (so far as is known) nowhere else in the world. It is a striking commentary on current views on evolution that no one could possibly suggest any way in which the differences from the normal could be of any use to the lake species.

Perhaps the most remarkable find was a little worm (*Lycaestis quadraticeps*) of the class Polychaeta. This enormous group is almost without exception marine. I was astonished to find a Polychaet not only in fresh water, but more than 1000 feet above the sea and separated from it by a large waterfall. The species has never been found before except in South America, and then either in the sea or in fresh water easily accessible from the sea.

On the appointed day our carriers returned, and we went back to Nombur. We had not waited many days when one morning before dawn we saw a light out to sea. We waved our lamp about to attract attention. Shortly afterwards a cutter put in through a breach in the reef further north. Mr. Thomas had most kindly sent his boat all the way from Hog Harbour, 75 miles away, to bring us back.

The Ascent of Mount Tabwemasana Tauku

In the old Admiralty Charts of Espiritu Santo the highest mountain marked is Losubunu, or "Santo Peak" (5520 feet), in the south-west of the island. The two previous attempts to climb the highest mountain in the New Hebrides were attempts on Losubunu. The first was made by Sir Douglas Mawson, the second by Dr. F. Speiser. The former seems not to have ascended much above 4000 feet; the latter seems nearly to have attained the summit, but unfortunately he did not survey his route.

The map of the French *Ministère des Colonies* and a more recent edition of the Admiralty Chart show that Losubunu is not the highest mountain. Both mark a higher peak considerably further north, inland from the coastal village of Wus. The height is given in the French map as 1880 metres, in the Admiralty Chart as 6169 feet. This mountain, which is not named in the maps, is Tabwemasana, the highest mountain in the New Hebrides. Between Tabwemasana and Losubunu is a double peak of 5488 feet, almost the same height as Losubunu.

I was accompanied on the ascent of Tabwemasana by Mr. T. O. Thomas and Mr. J. de H. Morel. Starting in a southerly direction from Hog Harbour,

we sailed round the island in Mr. Thomas' cutter and arrived on the third day at Tasiriki, just past the south-western corner of the island. We did not proceed further that day on account of the heavy tide-rip which we saw extending all the way to Wus, and which would almost certainly have made the anchorage there unsafe. A few natives came from the village to see us. We explained our project and told them we wanted volunteers to carry.

At Tasiriki there live a white man and his wife, engaged chiefly in the cultivation of coconuts. All the way up the west coast from here the country is mountainous, with scarcely any level ground on which to make a plantation. Further, there are no harbours, nor even an anchorage which is safe with a westerly swell. It is not surprising that there is only a single European living on the 100 miles of coast stretching round from Tasiriki to near the south-western corner of Big Bay. Needless to say, there is no European living inland.

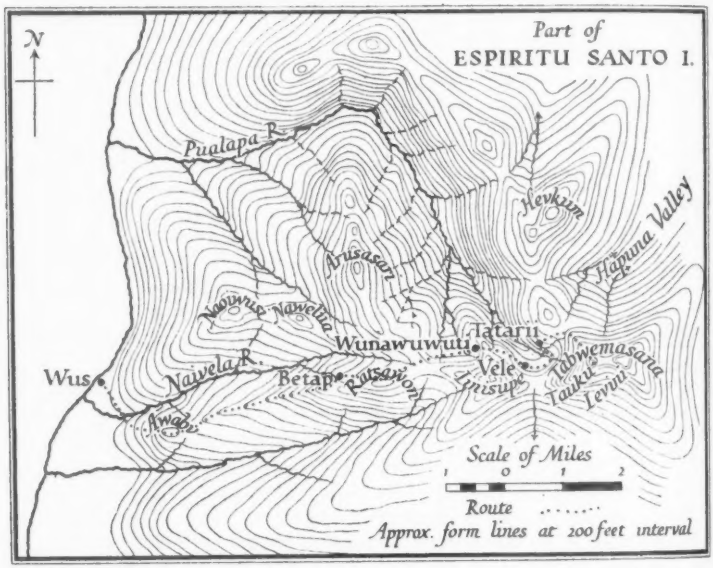
Two days later three men and four boys who had volunteered as porters came on board early. One of them was a murderer who had fled from the rough justice of his native village and was delighted to find safety with us in the mountains. We sailed 20 miles up the coast and were able to anchor safely at Wus, the direction of the wind being favourable. The Rev. F. G. Bowie, who had most kindly put his valuable knowledge of the west coast of Espiritu Santo at our disposal, had sent word a long time before to the people of Wus that we were coming. It was largely owing to this that we were able to get sufficient porters. In all, counting those we had collected at Tasiriki, we had sixteen. This was just sufficient. One was a boy with a sore on the sole of one of his feet, which caused him to hobble rather than walk. He was determined to come, and he did; but it is stretching the point to describe him as a carrier.

The sketch-map shows our route from Wus to Tabwemasana. The coast-line is from the map of the French *Ministère des Colonies;* the rest is from my survey. The map was drawn from my survey by my brother, Mr. S. J. Baker, and re-drawn for publication by the draughtsmen of the Society. Distances were measured by time on the march, directions by prismatic compass, and altitudes by $4\frac{1}{2}$-inch aneroid barometer, checked against three-hourly readings of an identical barometer at sea-level. The sea-level readings were kindly taken by Mr. O. Stevens, who was in charge of the cutter during our absence inland. The form-lines are 200 feet apart. The elevations of places not on our route are only estimated.

We left Wus on 5 July 1927. After crossing the river Naivela we made a steep ascent on to the crest of the Awabo ridge. Once we were on it, ascent was more gradual for a couple of miles. The crest of the ridge is only a foot or two wide in many places, with steep slopes on both sides. In many places forest vegetation extends right up to the ridge on the southern slope, and long grass right up to the ridge on the northern slope, giving a most curious aspect to the scene. Grass occurs naturally nowhere in Espiritu Santo except on the northerly faces of the western chain of mountains. Everywhere else there is dense forest. Probably the cause of the curious distribution of the grass lands is the lesser humidity on the northern slopes, owing to the sun being to the north during the greater part of the year.

A sharp ascent, followed by a slight descent to a small tributary of the Naivela, brought us to the little village of Betap, at 3500 feet. Here we camped for the night, sleeping in one of the huts. Several of the people of Betap joined our party as porters. Next day, after a small climb, we crossed the crest of a range of four mountains which I shall call the Linisupe-Arusasari range from the names of two of the mountains. This range leads to Tabwemasana. Beyond it, to the north and east, lies the valley of the river Pualapa, and beyond the valley another range of mountains, which I shall call the North Pua range, and which also leads to Tabwemasana.

The vegetation here on the northern slopes of the range is grassy, except in the little valleys of streams running down to the Pualapa, where there are wooded patches. Without changing our elevation very much we now walked



along the north side of the crest of the range almost directly towards Tabwemasana, passing the deserted villages of Wunawuwuti and Vele. Between these two villages, on a spur running down into the valley from Mt. Linisupe, is a bare patch of ochreous ferruginous clay. It is curious that the natives of the New Hebrides should be ignorant of the smelting of iron from its ores, when it is so abundant.

About half a mile past Vele we were at the base of Tabwemasana itself. Our guides brought us across the little stream called Riris, which rises on Tabwemasana and forms the highest source of the Pualapa. We next began to ascend the North Pua range, and camped for the night at the village of Tatarii (4000 feet). We were very cold in our little huts at Betap and Tatarii, after the steaming heat of the New Hebridean climate at sea-level.

On the morning of the 7th we started early. Our first move was to attain

the crest of the North Pua range. This we did at a pass leading over into the Hapuna valley. The river Hapuna flows into Big Bay some miles west of the outflow of the Yoro. From the Pualapa–Hapuna pass we could see the large lake-like expansions which the Yoro forms before narrowing suddenly to flow out to sea.

Turning to the right, we now climbed along the ridge forming the continuation of the North Pua range on Tabwemasana itself. I may here quote from my journal: "It was a steep climb along a knife-edge ridge nearly the whole way. It would have been quite impossible to climb had there been no vegetation. We clambered up from branch to root and root to branch, always with an almost sheer drop on each side. A considerable part of the ridge is clothed with Pandanus. None of our twenty-six porters had been at the summit before. Some of the sea-coast natives were frightened, but actually there was no cause for alarm, as one could not have fallen far through the thick vegetation."

We arrived at the summit at 10.53 a.m. The actual summit of the peak we had climbed is only 2 or 3 square feet in area. Here we half buried a bottle containing an account of our ascent. The vegetation of the summit consists of trees on every side, among them *Metrosideros collina*, (Forst.) Gray. The thermometer registered shade temperatures of 61·5°, 61·5°, and 62° F. at 12, 1 and 2 o'clock. 62° F. (16·7° C.) must have been the maximum for the day. It is not surprising that our carriers felt very cold. The *minimum* temperature for the same night and day at Hog Harbour was 72° F.

Visibility was excellent from north-east to west, but dense fog prevented us at first from seeing anything to the east. The natives had told us that Tabwemasana was a double peak, one of the peaks (that which we had climbed) being called *Tauku* (=man) and the other *Levini* (=woman). They all said that Tauku was the higher. Shortly before we left the fog lifted, and we got a splendid view of Levini. I at once took out my clinometer and found that our informants were wrong, Levini being nearly 7° above the horizontal from the summit of Tauku. My corrected barometer reading gave 6025 feet as the height of the summit of Tauku, which compares well with the Admiralty Chart figure of 6169 feet, which presumably represents Levini.

We had intended to camp at the summit overnight so as to make as thorough a collection of the fauna as possible and to record the minimum night temperature, but owing to the cold nothing would induce our carriers to stay with us, nor would they agree to come back next day for our camping gear if the white men of the party stayed there alone overnight. They had therefore carried all our camping gear and food to the summit to no purpose, and we had to return to Tatarii for the night.

The whole party was engaged during the greater part of our stay at the summit in making a collection of the fauna. Of the thirteen species so far reported on, no fewer than nine are peculiar, and seven appear to be new species. A common little yellow beetle with four black spots, *Ceratia quadrimaculata*, was the only species among them which I had previously found in the islands in a year's collecting.

The animal which surprised me most was the Amphipod, *Orchestia platensis*, Kröyer. The Amphipods are a group of small, flattened, super-

ficially shrimp-like Crustacea, which one often sees swimming about on their sides in fresh water. Nearly all the members of this group are marine or fresh-water, and I could hardly believe my eyes when I saw them at the very summit of the mountain, more than 6000 feet above the sea and far from any stream or pond. Nowhere else in the New Hebrides did I see a terrestrial Amphipod. Professor W. M. Tattersall kindly examined my specimens and identified the species, which is very widely distributed, being found in North and South America, Africa, India, the Low Archipelago in the Pacific, and elsewhere. With one exception it has never been taken except on the seashore at or near high-tide mark. It would have been almost as peculiar to have found a limpet 6000 feet above the sea.

That evening at Tatarii I offered two cases of tinned meats to any two natives who would help us to make an attempt on Levini the next day. Even this (to them) enormous bribe failed to draw a single man. They insisted that the ascent of Levini was everywhere precipitous. This had certainly not appeared to me to be the case when I had viewed it from the summit of Tauku; but they assured us that although several natives had climbed Tauku in the past, no one had ever been able to achieve the ascent of Levini. Mr. Thomas added a further bribe, but to no effect. The work of cutting a path for ourselves as well as carrying food, water, and camp equipment would have been impossible without native assistance, so we were forced to abandon the project. We remained at Tatarii that night, and returned by the same route as that by which we had ascended, sleeping once more at Betap on the way.

The name "Santo Peak," as a synonym for Losubunu, gives the misleading impression that this is the highest mountain in the island. Since Tabwemasana and not Losubunu is the highest mountain, the name "Santo Peak" should be discarded. Though Tabwemasana is not a large mountain, yet it cannot be denied a certain grandeur, rising as it does to its 6000 feet within 10 miles of the sea.

Depopulation

There is no doubt that there has been a great decrease in the number of natives in nearly all the islands of the New Hebrides during the last half-century. What is the cause of this decline? Unfortunately, depopulation is a subject on which little work has been done which can lay any just claim to be called scientific. A psychologist visits a depopulated area and pronounces depopulation to be due to psychological causes; a missionary points to polygamy, an atheist to the dying-out of polygamy, a malaria expert to mosquitoes, and an anthropologist to loss of power by chiefs: yet guesswork, powerfully aided by preconception, would be a more fitting name than Science for their investigations.

My method was to take vital statistics of a large part of Espiritu Santo, and as far as possible to find whether a suggested cause was operative or not by reference to these statistics. To do this I visited personally as many of the villages as possible, and got information about every single person from a few men in each village. The Melanesian loves talking about his relations, and my informants were as bright as ever when I was quite weary after a long session. I often proved the accuracy of their information by getting them to repeat it: invariably the details were the same.

On one occasion we came to a village where for a long time we could find no one from whom to extract information. At last my wife and I came upon a man sitting by a minute hut at some distance from the village. We stretched out our hands to signify friendship, and he took them in his. Our carriers stood somewhat apart to interpret our conversation. When he turned round we saw the most ghastly sores on his back. Two hours later we were back at a mission station, and told the missionary that our informant in this particular village had been one Ngudh. I shall not easily forget the wild rush for the lysol bottle, to cleanse our hands from the touch of a noted leper! Actually the disease is less contagious than is usually supposed.

In the course of my journeys throughout eastern Espiritu Santo I came again and again upon most curious patches of country, each a few acres in extent, with a vegetation wholly different from the usual forest. In these patches there are no forest trees, but only a luxuriant growth, about 4 feet high, of a plant called Ipomoea. At the borders of these patches Ipomoea climbs the forest-trees to their summits, so that whether one looks up or down one sees nothing but the huge heart-shaped leaves of this plant. At first I sought some natural explanation of these weird patches, but my carriers soon corrected me; they are the sites of the gardens of deserted villages. In nearly every case my carriers could tell the name of the village, and usually they remembered the village when it had been inhabited. Their expressive phrase "All 'e die finish" answered my query as to where the inhabitants had gone. In the map which resulted from my journeys these deserted villages are marked in small letters. One cannot fail to be appalled at the depopulation which they bespeak. I will take in turn the chief causes which have been supposed to be operative.

First there is apathy due to loss of old customs, a supposed psychological cause suggested by Rivers. Some people suppose that depopulation occurs when there is no desire for children, as though this particular state of mind could in some magical way affect fecundity. Some claim that the people simply die off from boredom, though there are no statistics showing that death from this cause has ever in any part of the world accounted for a significant part of the death-rate. Others are much more rational in their arguments, contending that when primitive peoples lose their old customs, they begin to limit their families.

In Espiritu Santo I was able to disprove this contention completely. Here we have Christianized coast villages on the one hand, where the old customs are no longer practised, and heathen inland villages, where the old customs are retained and there is no white influence (other than the spread of disease). By comparing vital statistics in Christian and heathen villages, I have been able to show quite definitely that the number of children is proportionately greater in Christian than in heathen villages. In Sakau there are 164 children per 100 adult females in the Christian villages, and only 120 per 100 adult females in the heathen villages. In the rest of the island the discrepancy is even greater (171 to 79 children per 100 adult women). Loss of old customs does not cause depopulation, for the proportion of children is greater in the villages in which the old customs have been lost. It will not help to pretend, as has been done, that Christianity has replaced in some way the excitements

of savage life. Let any one who thinks so attend a chief-making ceremony in the interior after spending a few months in a Christian village!

Stress has been laid by some on the endemic diseases of malaria and yaws, but although these are very prevalent, they seem seldom to be fatal. Probably they reduce the resistance to the vastly more lethal introduced diseases. The most important of these are influenza, measles, dysentery, and tuberculosis. The natives have very little resistance to influenza and measles, and die off in great numbers in epidemics. Dysentery spreads rapidly owing to the absence of sanitary arrangements. Without doubt introduced diseases are one of the most important causes of depopulation throughout the island.

In Sakau I found the sex-ratio to be 159 males to 100 females. It seems probable that this may be the highest sex-ratio of any tribe in the world. It must be an important factor in depopulation; for in a polygamous country in which practically all the women marry, the rate of reproduction depends on the number of women.

In order to show the effect of sex-ratio on depopulation, I have postulated certain birth-rates, death-rates, etc., which would result in the numbers of the community remaining constant indefinitely with a sex-ratio of equality. I have shown mathematically that the population would fall to approximately *one-tenth* of what it was in three hundred years if the sex-ratio changed from equality to that of Sakau.

Some may ask, "Why prevent depopulation?" I think there are two reasons. Firstly, the people are worth saving on their own account. Their honesty in not stealing, their independence of character, their high spirits and sense of humour, their friendliness, their charity in giving food to the helpless, are characters which demand their preservation, despite such drawbacks as the perpetual vendettas. Secondly, we have in the interior of certain of the islands a primitive people living their primitive life as it has been lived for centuries. We are vandals if we allow such anthropological treasure to be lost by depopulation or spoilt by white influence. The animals which are most interesting anatomically (such as Ornithorhynchus in Australia and Sphenodon in New Zealand) are most carefully protected by law; but over nearly the whole of the world we have allowed the most primitive peoples to lose their old mode of life, and in some cases have killed them off by introducing diseases.

I consider, then, that our principles should be to prevent both depopulation and the loss of old customs. I suggest that a small island should be strictly quarantined for twenty years or so. If any whites held land on it, they should be compensated and removed, and no one, white or native, should be allowed to approach within a mile of the island during the quarantine. If the population were found to have increased markedly at the end of the period, the quarantine might be renewed, and perhaps extended to other islands. The quarantine would have to be preserved by occasional visits from a government vessel, coupled with a system of heavy punishments for any outsider found within a mile of the island. This I call the administrative scheme to prevent depopulation.

An alternative scheme for quarantining an island might be called the philanthropic. If a sufficient sum could be raised by public subscription, the

traders and planters on neighbouring islands could be asked to enter into a bond (in return for financial compensation) never to land on the island concerned, nor to bring natives to or from it, and the Missions might be asked to leave it alone as far as possible.

The natives of oceanic islands have a great natural disadvantage and a great natural advantage in the matter of depopulation. On the one hand, their isolation from continental areas has resulted in their not having evolved any resistance to such diseases as influenza and measles. On the other hand, the presence of sea all round makes their quarantining an easy matter, whereas it would be almost impossible to quarantine completely a small tribe living in a continental area. The natives of the New Hebrides have suffered terribly from their great disadvantage; let us see to it that some of them at least profit by their great advantage.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: Away to the east of Australia, some 1500 miles distant, there is a chain of islands christened by Captain Cook the New Hebrides. That chain of islands is some 500 or 600 miles long, being tropical and almost entirely volcanic. The islands suffer from a form of government known as a Condominium; that is to say, France and England jointly govern. Mr. J. R. Baker, who is going to lecture to us to-night, has paid two visits to the islands, and is, I believe he would say, essentially a zoologist, but he embraces in that description the provinces of anthropology and ethnology; and I think we may also claim him as a geographer because, as will appear from his lecture, he has been the first to visit and explore, at any rate scientifically, the largest lake in those islands and the first to climb one of the highest mountains there. I will now ask Mr. Baker to describe his experiences.

Mr. Baker then read the paper printed above, and a discussion followed.

Mrs. J. R. BAKER: I would like to say how, after a few months among the New Hebrideans, I feel something ought to be done to prevent them dying out. Now that the danger is becoming realized perhaps an interest will be taken in them and some system of quarantine or other scheme forthcoming. There was one little incident my husband omitted. When that very charming New Hebridean showed us the way to the geysers we felt we must reward him in some way. We had nothing to offer him except a tin of meat, or a few safety-pins; I thought as they were very useful to us they would be so to him, and so offered him the safety-pins. He was very pleased to take them, and immediately undid them and stuck them right through his ear!

The PRESIDENT: Is there any one else who would like to add a few words? Well, it is obvious from the lack of response that we have listened to an account of a refreshingly new subject. What we have heard to-night is probably unfamiliar to most of us. We all feel, I think, that what Mr. Baker has said about the necessity for preserving those native races should be brought home to the authorities. Why should it be impossible to isolate, for instance, the island of Gaua? I should like it to go forth from this great Society that this experiment should be tried in the interest of the natives; that one of the islands should be isolated with a view to preserving the natives and their individuality. As we have heard, the natives are disappearing under the existing conditions, and the existing conditions leave much to be desired. In your name I thank Dr. Baker for his interesting and witty lecture on an unfamiliar subject.

THE CAMBRIDGE PENDULUM APPARATUS: *Read at the Afternoon Meeting of the Society 14 January 1929, by*

COLONEL SIR GERALD LENOX-CONYNGHAM, F.R.S.

THE Cambridge Pendulum Apparatus had its origin in a desire on my part to have an apparatus and set of pendulums made in this country which should embody some ideas that had arisen out of my experience with the apparatus, now more than a quarter of a century old, which I had used in India. I was engaged on the design of such an apparatus when Dr. Vening-Meinesz published his account of the method that he had devised to meet the peculiar difficulties presented by the instability of the ground over a large part of the west of Holland. This publication suggested a revision of the design I had been making, and the apparatus that I am going to describe is the result of that revision; but I should like to draw your attention to the long step there is between the general sketch of a piece of apparatus and its actual construction. The French draw a useful distinction between the person by whom an apparatus has been *imaginé* and him by whom it has been *réalisé*. I took my general ideas to the Cambridge Instrument Company, and it was they who brought it to fruition. I wish particularly to say that the late Sir Horace Darwin devoted much thought to the apparatus, and that many of its parts were specially designed by him.

Before describing the apparatus it may be advantageous to examine the problem which pendulum observations are intended to solve. The original objective of the pendulum observer was the determination, through Clairaut's Theorem, of the amount of the flattening or ellipticity of the Earth's figure. But, as happens in all geodetic attacks on this problem, the distant goal is found to be surrounded by many sources of uncertainty, and until these have been investigated further progress cannot be made. The observer, whether of the direction or of the intensity of gravity, becomes entangled in questions regarding the distribution of mass in the Earth's crust, and has to adapt his methods to the investigation of these problems. He therefore requires to take account of the effects on gravity which would be produced by recognizable geological features, and it is this consideration which determines the order of accuracy that is necessary.

Now, the attraction of a stratum of rock of average crustal density on a point situated at or above its centre is approximately $3gh/4R$, where h=the thickness of the stratum and R=the radius of the Earth. Taking g=980 cm./sec.^{2} and R=6,380,000 metres, and putting h=10 metres, the attraction is

0·0011 cm./sec.^{2}

A stratum 10 metres thick is quite a considerable feature, so we see that we cannot ignore 0·001 in the value of gravity. As gravity is about 980 cm./sec.^{2}, we are therefore obliged to try to measure with an accuracy of 1/980,000, or, in round numbers, 1 in a million.

Since the time of swing of a pendulum varies inversely as the square root of the force of gravity, $dg/g=2ds/s$ (where s is time of swing). Hence, if $dg/g=1/10^6$, $ds/s=1/2\times10^6$. The time of swing of these pendulums is about half a second, hence $ds=1/4\times10^6$ sec. nearly. We may say, then, that in determining the time of swing we cannot ignore an error of (2×10^{-7}) sec.

Let us now examine the errors to which the determination is liable. The method employed is that of coincidences. That is to say, a series of coincidences between the pendulum, whose period is about 0·506 sec., and a clock or chronometer beating seconds is observed. It is easy by a short series of observations to determine the interval between two selected coincidences correct to the tenth of a second, so far as the mere observing is concerned, and this is true whether the selected coincidences are near together or far apart. If we denote the interval between consecutive coincidences by c the relation between c and s is $s=c/(2c-1)$. Hence $ds/dc=-(2c-1)^{-2}$.

With these pendulums c is about 40 seconds, therefore if $dc=0{\cdot}1$, $ds=1/64{,}000$ nearly.

To reduce this to $1/4\times10^{6}$ we must divide by about 60; that is to say, we must measure a 60 coincidence interval by observing two series of coincidences separated by this interval, which is equal to 40 minutes. Thus we see that so far as the mere observing goes one should easily reach the required accuracy in one hour.

Consider next the rate of the clock or chronometer with which comparison has been made. If the clock has a rate of 1 sec. per day the observed period of the pendulum will be in error by 1/86,400 of itself. The error in s will then be (58×10^{-7}) sec. Hence if the rate is determined by wireless time signals (assumed to be errorless) 24 hours apart, we must endeavour not to commit an error of one-twenty-ninth of a second.

If the rate is determined by the Rugby signals at 10 and 18 hours, the error of the determination should not exceed one-third of the above, or 0·01 sec. in round numbers. The difficulty of securing so high a precision is increased by irregularities in the clock's rate, as distinct from the magnitude of the rate between time signals, but as this is a matter which is not affected by the design of the pendulum apparatus I shall not discuss it further.

The observed time of the pendulum's swing has now to be reduced to what it would have been in a standard state. We require therefore corrections to reduce the observed time to what it would have been if the pendulum had been swung:

1. In vacuo.
2. At 0° C. temperature.
3. With an infinitely small arc of vibration.
4. On a perfectly steady and rigid stand.

1. *Reduction to vacuum.*

The correction amounts to about $-(0{\cdot}82\times10^{-7})\times$pressure in millimetres of mercury.

In the Cambridge apparatus an airtight chamber is used and the pressure can easily be regulated. The small manometer inside the chamber has a column of mercury about 150 mm. in height, so it cannot measure a pressure greater than that. Unless it is desired to make very long swings, in which case the damping power of the air must be reduced as much as possible, there is no particular object in making the pressure very low, and the usual practice is to observe at a pressure of 60 to 80 mm. The pressure constant has been well determined, and even if the pressures at the different stations differed by

considerable amounts—if, for instance, the chamber could not be pumped out and observations were made at atmospheric pressure—it is believed that the correction would not be liable to an error of more than about (3×10^{-7}) sec. With controlled pressures, therefore, we may feel confident that no appreciable error due to this source can arise.

2. *Temperature Correction.*

This is more difficult chiefly because of the uncertainty of the temperature of the pendulum. Thermometers show their own temperature well enough, but there may be a considerable difference between the temperature of the bulb of a thermometer and that of the stem of a pendulum attached to a massive bob. To overcome this difficulty a dummy pendulum with a hollow stem containing a thermometer is used, but the question then arises, where should the bulb be placed so as to indicate the average temperature of the pendulum? The practice is to put it just where the stem joins the bob, but I am not sure that this is right.

In order to reduce the effect of this uncertainty it is desirable to make the pendulums of a material with a low thermal expansion. The pendulums of the Cambridge apparatus are made of nickel-steel, of the same composition as *Invar*, supplied by Messrs. Cammell, Laird & Co. to the Cambridge Instrument Company.

With brass pendulums the correction is of the order of $-(45\times10^{-7})\times t^{\circ}$ C. It is therefore necessary to know the temperature to 0·05 if the correction is to be right to (2×10^{-7}) sec. The coefficient of expansion of invar varies a good deal from one ingot to another. Experiments at Sèvres gave values from $3{\cdot}3\times10^{-7}$ to $0{\cdot}4\times10^{-7}$ per 1° C., while the corresponding figure for brass is 190×10^{-7}. The coefficient of expansion of the Cambridge pendulums has not been determined directly but may be inferred from the temperature correction to the time of oscillation which has been carefully observed. This correction is $-(0{\cdot}5\times10^{-7})\times t$, where t is the temperature on the Centigrade scale. This corresponds to a coefficient of expansion of (2×10^{-7}) per 1° C. With these pendulums, therefore, if the temperature is wrongly estimated by as much as 3° the effect on the time of swing will be less than (2×10^{-7}) sec. So gross a discrepancy between the real temperature of the pendulum and the thermometer reading seems improbable, and it is therefore reasonable to hope that with these pendulums the temperature difficulty has been overcome.

3. *Reduction to an infinitely small arc.*

This presents no difficulty. It is generally quite sufficient to take the mean of the initial and final amplitudes of the pendulum's swing and to apply a correction $=s\alpha^2/16$, where α is the circular measure of the mean semi-amplitude. The arc is measured by observing in the telescope the movement of the image of a scale reflected in the mirror on the pendulum. It is easy to determine the arc with ample precision.

4. *Reduction to a rigid stand.*

Two cases have to be examined. The first and simplest case is that of an observation made on firm ground, where a pendulum if brought to rest will remain at rest indefinitely. In this case we have only to consider the swaying of the stand by the pull exerted by the swinging pendulum itself.

It is easy to see the nature of this movement. When the pendulum swings to the left the line of the knife-edge moves a little in the same direction, and similarly when it swings to the right. If then we draw a line from the centre of gravity of the pendulum through the knife-edge when at the end of the movement to the left and also at the end of the movement to the right, we shall have two lines which meet at a point above the plane of suspension, and the pendulum will behave as if its knife-edge were situated at that point; its length will receive a small virtual increment (Fig. 1).

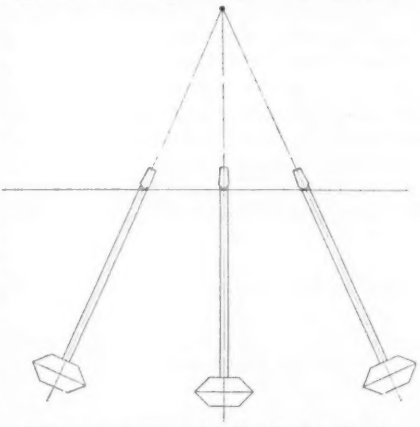


Figure 1. Increase in effective length of a pendulum with swaying support

Means of measuring this small virtual increment have been devised, and they are quite successful, but they involve the use of special additional apparatus and they take a certain amount of time. The amount of the correction with the apparatus that was used in India from 1903 until 1914 (made by Schneider of Vienna to von Sterneck's design) was from 30 to 80 units of the 7th decimal of a second, according to the quality of the pillar and the tightness of the clamping of the stand to the pillar. The Mendenhall apparatus used in the U.S.A. and in Canada is more rigid, and I believe the correction is about 10 units on a good pillar.

It is clear that if two pendulums of equal period and mass are set swinging in opposite phase on the same stand their swaying effects will always be equal and opposite and the stand will be undisturbed, and when the Combridge apparatus was designed it was decided to eliminate sway instead of measuring it.

It is necessary that the two pendulums should have their periods so nearly equal that they will remain in sensibly opposite phase throughout an entire swing. If we allow a departure from exact opposition of one-tenth of the time of oscillation—that is to say, if one pendulum reaches its extreme position 0·05 sec. after the other—then, in order that 8-hour swings may be used the periods of the two pendulums must not differ by more than (10×10^{-7}) sec.

To attain this equality is rather a tedious piece of work. It is done by slowly grinding the base of the longer of the two pendulums which are being equalized on fine emery paper laid on a piece of plate glass. More time has to be spent on observation to ascertain how much has still to be ground than on the actual grinding, at least after the first approximation to equality has been made.

When these pendulums were first made this equalization was done by Mr. J. B. Laws, now in the Survey Department of Tanganyika Territory; and a second adjustment, after the pendulums had undergone some alteration, was done by Colonel Craster while I was in Japan in 1926. The difference

between the times of oscillation of the pendulums after adjustment amounted on both occasions to (5×10^{-7}) sec. or less.

The other case that has to be considered is that of a pillar on an unstable foundation. This was the problem with which Prof. Vening-Meinesz was faced when observing in Western Holland, and which he so brilliantly solved. The Cambridge apparatus is so designed as to be able to take advantage of Vening-Meinesz's method, though so far no occasion for its employment has arisen. To use this method a third pendulum swinging in the same plane as the other two and placed midway between them, is necessary. It will be easier to explain this after the general plan of the apparatus has been described.

The Pendulums.—The bob, stem, and head of a pendulum are made from one piece of nickel-steel; there is no joint. The knife-edge is made of stellite, an extremely hard and incorrodible substance made, I believe, of chromium

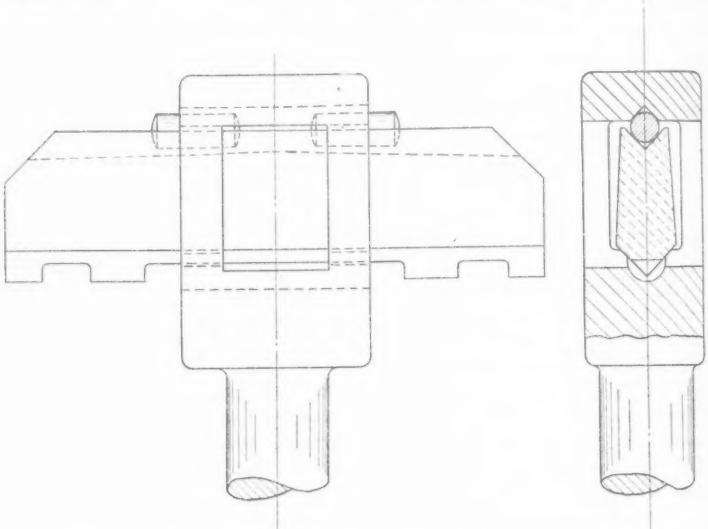


Figure 2. Form of the knife-edge and head of gravity pendulum

and cobalt, with the admixture of a small quantity of molybdenum. The form is shown in Fig. 2 and plate 3. After being placed in position the knife-edges are secured by a pair of wedges very firmly pressed home. Stellite is capable of receiving a high polish, and advantage has been taken of this to do away with the usual silver-on-glass mirrors. The sides of the pieces of stellite have a slope of about 1 in 12, and on both sides the part that lies within the frame formed by the head of the pendulum is highly polished. Thus when a pendulum is suspended in its position of rest the stellite provides two mirrors, each inclined to the vertical at a slope of about 1 in 12.

I shall not describe in detail all the parts of the apparatus, but will confine myself to those features that were designed to meet the needs of which I have spoken. I may enumerate them:

1. An airtight chamber.
2. Means of observing two pendulums simultaneously.
3. Means of setting two pendulums in motion at the same instant, in opposite phase and with equal amplitudes.
4. Means of utilizing the Vening-Meinesz method when the ground is unstable.

1. *Airtight Chamber.*

If an airtight chamber is required it is very advantageous to make the walls of the chamber support the pendulums; not to support the pendulums on a central structure and put a cover over the whole. This advantage has been secured. There is a long chamber divided into three compartments, in each of which a pendulum can be swung. A stiff platform of gun-metal, securely bolted to the chamber, carries the agate planes on which the pendulum knife-edges rest, and other fittings.

There are four stuffing boxes through which rods pass from the inside to the outside. Of these three are connected to the starting levers of the pendulums, and the fourth actuates the levers which lift and lower the pendulums. Much attention was paid to the design of these stuffing boxes, and they possess in addition to the usual features an oil seal designed by Sir Horace Darwin, which is of great value.

2. *Means of observing two pendulums simultaneously*

It may be useful to describe very briefly the method by which coincidences between the oscillations of the pendulums and the beats of the clock or chronometer are observed. The clock or chronometer is fitted with electric contacts so that a current can be made to pass for a moment every second. This current is made to actuate a shutter so that a little window in a contrivance called the flash-box is opened once every second and a flash of light is allowed to pass. This flash is made to fall on the mirror of a pendulum, and thence, when the pendulum is at rest, it is reflected into the observing telescope, which in turn is adjusted so that the flash coincides with the horizontal cross-wire. The time of oscillation of the pendulum is a little more than half a second (about 0·506 sec.), so that in the interval of one second between consecutive flashes the pendulum does not quite complete a double oscillation. Thus, if when the first flash occurs the pendulum is exactly vertical and moving towards the left, when the second flash occurs it will be somewhat to the right of the vertical position, so if the first flash is seen on the cross-wire of the telescope the second will be seen a little above it, the third still further above, and so on until a stage is reached at which the flash occurs before the pendulum has completed its excursion to the right; thereafter the procession of flashes will change direction and will approach instead of receding from the cross-wire. When the flash again coincides with the wire it is clear that the pendulum has lost one whole oscillation. By timing these coincidences we have the means of expressing the time of oscillation of the pendulum in clock seconds. With two pendulums swinging simultaneously we have to arrange to have the two processions of flashes visible in the telescope at the same time.

The diagram, Fig. 3, explains the arrangement. The two sets of flashes are seen one above the other in the field of view of the telescope.

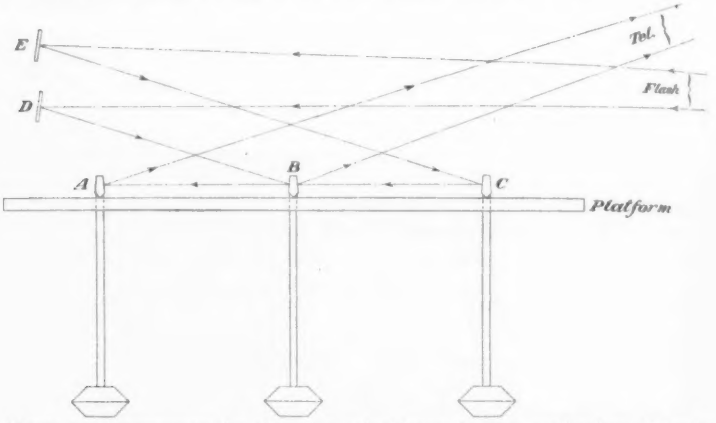


Figure 3. Arrangement for observing coincidences between oscillations of pendulums and beats of clock

The flashes emanate from the flash-box which is to the right of the diagram. D and E are two small adjustable mirrors. The light that falls on D is reflected to the left side of pendulum B, thence to the right side of A, and from A to the telescope. Similarly light from the flash-box falling on E is reflected to the left side of C, thence to the right side of B, and to the telescope. The pendulums A and C are those that are set swinging in opposite phase; normally, that is to say if the ground is stable, B does not move at all and may very well be replaced by a pair of mirrors set back to back at the proper slope. It is remarked that the two paths of the flashes, from flash-box via BDA to telescope and from flash-box via ECB to telescope, are of the same length, so that both flashes are in focus together. In order that the two series of flashes may be conveniently observed the field of the telescope is provided with two horizontal wires separated by a distance corresponding with that between the images of the flashes when the pendulums are at rest.

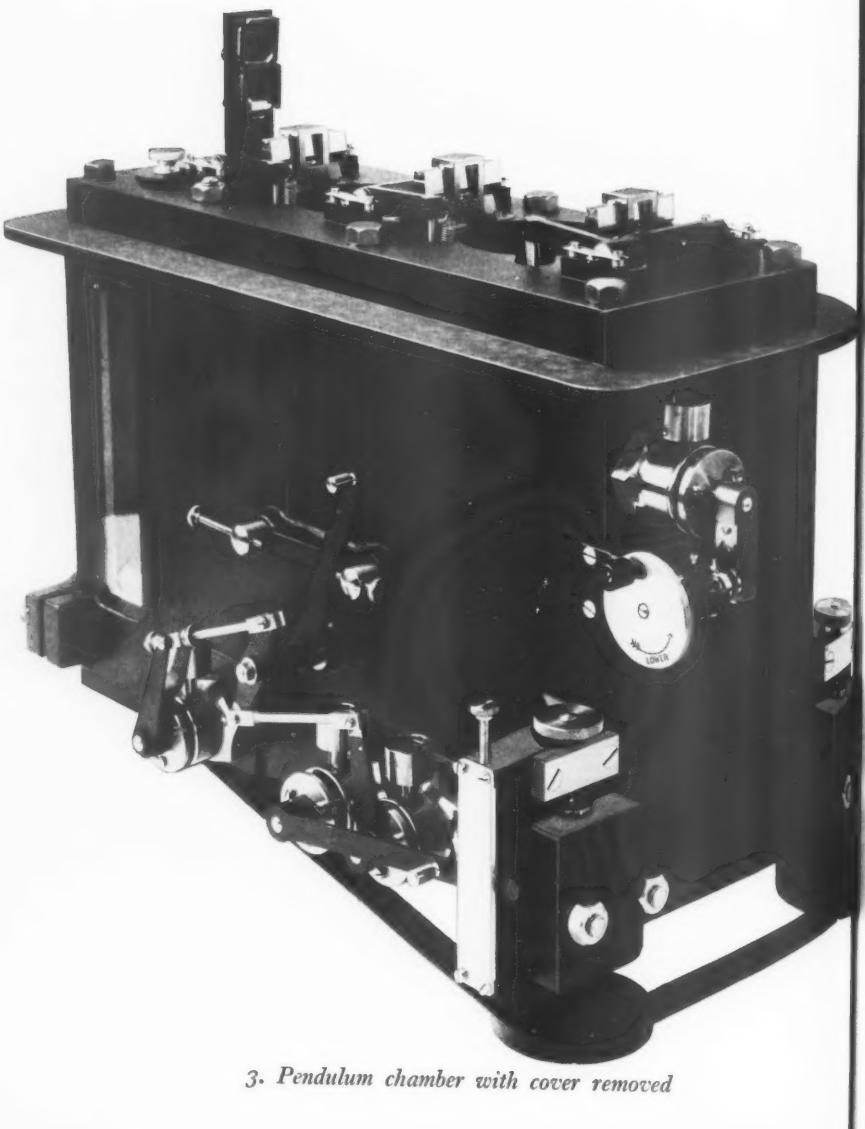
3. *Means of setting two pendulums in motion at the same instant, in opposite phase and with equal amplitudes.*

The axles to which the starting levers of A and C are attached have corresponding levers fixed outside the chamber. These are connected by links (Plate 2) to opposite ends of a cross-bar pivoted at its middle point. Thus rotation of the cross-bar about its pivot imparts opposite rotations to the two starting levers. One of the links is adjustable in length, so that it is possible to equalize the amounts by which the pendulums are respectively displaced from their position of rest. This ensures that they shall be started with equal amplitudes. Stops are provided to control the amount of rotation given to the cross-bar and so to regulate the amplitude imparted.

In Plate 3 the device by which the pendulums are lifted and lowered may

1 *Gravity pendulum*

2. *Pendulum chamber: showing arrangement of levers for starting pendulums*



3. Pendulum chamber with cover removed

be seen, at the end of the case immediately below the flange. I need not describe it in detail.

4. Lastly we come to the means of utilizing the Vening-Meinesz method in places where the ground is unstable.

Those who heard Prof. Vening-Meinesz describe his method to this Society will see at once that the third pendulum suspended between the other two, which is initially at rest, provides what is required. I shall not attempt to go into the details of the method, but the general principle is easily understood. Reverting to Fig. 3, if the platform on which the knife-edges of the pendulum rest receives a small horizontal displacement towards the left, the knife-edge of A will be moved to the left, the bob remaining for an instant unmoved; thus the ray of light proceeding from A to the telescope will be deflected upwards, but B will be moved in precisely the same way, and as the ray of light is reflected from the other side of B it will be deflected downwards and these opposite deflections will be equal, so that in the telescope no movement is perceived.

The result is that the doubly reflected ray is unaffected by displacement suffered by the platform, and one obtains by the usual observation of coincidences the time of swing that A would have had if the ground had been stable. The mirror on the other side of B acts in just the same way in connection with C, so that we obtain the times of swing of the two pendulums A and C.

I should perhaps remark that even if two pendulums were not used for neutralizing the sway it would be necessary to observe two pendulums in order to be sure that any difference from the Base station found at a Field station was attributable to a change in g and not to some change in the pendulum. If at the field station the difference A—C is found to be the same as it had been at the Base, we may be confident that the pendulums have not changed. If a change is found to have taken place, then by substituting B for A (or C) evidence may be obtained as to which of the two has proved inconstant. It is hoped that the method of construction of these pendulums will render inconstancy improbable. It has been objected to the use of invar for gravity pendulums that it is slightly unstable and that the length of a piece of invar increases for some time after it has been made. This is true, but the objection is not serious. It would be perfectly safe to regard the increase in length of a piece of invar as proportional to the elapsed time for any period up to about a year. Gravity pendulums are always swung at a Base station where the value of g is known both at the beginning and at the end of a campaign. If a change in length is found to have taken place, it will be safe to deduce the length at any intermediate date by interpolation. The kind of change that the use of a number of pendulums is intended to reveal is a sudden and apparently accidental one. They are not common occurrences, and it is hoped that with these pendulums they will not occur, though experience alone will be able to decide whether this hope is justified.

To sum up: I believe that the four corrections to the observed time of swing—temperature, density, arc, sway—should not either separately or in combination produce any appreciable error, and I hope that the stability of the pendulums will prove satisfactory. There remains, however, a source of error which I believe to be serious, namely irregularity in the time of the

emission of the flashes. One cause of this irregularity is variation in the lag between the make of contact in the clock and the opening of the shutter. Improvement in the flash-emitting device would be of much value. Another cause is irregularity in the rate of the clock and consequent uncertainty in the conversion of clock seconds into true seconds. The Shortt Clock has done much in providing seconds which only vary infinitesimally from true seconds. Wireless has done much in disseminating knowledge of the exact time. At one of the Meetings for the Discussion of Geophysical Subjects held last year at the rooms of the Royal Astronomical Society (3 February 1928) it was suggested by Mr. Hinks that it might be possible to develop such a system of cooperation between the Shortt Clock at Greenwich and the wireless emission, using short waves perhaps, as to enable any one in the British Isles at any moment to "listen in" to the beats of the clock, and so to measure any interval with which he was concerned in true seconds (*The Observatory*, March 1928, p. 86).

If ever this becomes possible the precision of pendulum observations will make a great advance.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: Sir Gerald Lenox-Conyngham has very kindly consented to give us a paper on the Cambridge pendulum. I think most of us will be interested in it, partly because we remember that it is just over one hundred years since systematic pendulum work was done in this country. Of course we know that a certain amount of work has been carried out at Kew and at Greenwich, but this was in connection with pendulum operations done abroad. We may hope that by the efforts of Sir Gerald Lenox-Conyngham, the Ordnance Survey, the Royal Geographical Society, the General Staff and other bodies interested, we may perhaps get something like a gravity survey undertaken in this country. Of course that is looking ahead some way, but I suppose that will be the ultimate outcome of these experiments.

Sir Gerald Lenox-Conyngham then read the paper printed above, and a discussion followed.

Rear-Adm. H. P. DOUGLAS (Hydrographer of the Navy): I was interested in Sir Gerald Lenox-Conyngham's remarks, especially as to clocks, because some little time ago when Dr. Vening-Meinesz was in this country he came to see me at the Admiralty with regard to the swinging of Shortt pendulums in submarines. I asked him how he got his time, and he said by means of time signals, and it occurred to me that the hourly rate of the chronometer, however good the chronometer, might differ from the daily rate divided by 24. I spoke to the Astronomer Royal about the matter, and he very kindly took it up and carried out some experiments for me, the report on which is, briefly, as follows:

The chronometers were compared with the standard clock which it was assumed was keeping a smooth rate throughout the experiments. From six months' observation for time determinations, made with the transit circle, there is no convincing evidence that the clock has made a change of daily rate between consecutive days amounting to 0·02 sec. Consequently the assumption of a smooth rate for the standard clock appears reasonable.

The chronometers used were those Admiralty ones fitted with contacts, and all comparisons were made automatically. The rate shown from these comparisons is the difference of rate between the chronometer and the standard clock.

The results for twenty-minutes records give the following variations in time from a smooth rate:

Chronometer.	*Max. variation.*	*Range of Variations.*
	s.	s.
V. Kullberg 8882	0·004 ..	0·007
V. Kullberg 9007	0·003 ..	0·005
Johannsen 7974	0·005 ..	0·008
Lindqvist 0104	0·005 ..	0·008

These quantities are small, and are of the order which may in part be produced by small irregularities in the travel of the tape and irregularities in making the scale readings.

During the period of test the chronometer was kept in a room open to temperature variations, and it is possible that a small compensation effect may be shown.

The conclusions of the tests are:

(1) During 20 minutes, reliable chronometers keep steady rates within the errors of observation and ordinary recording.

(2) A reliable chronometer may be expected to keep a regular rate during 24 hours within the limits of ordinary comparison with a standard, but may show a deviation from a smooth rate when compared automatically.

Capt. G. T. McCaw: My own recollection of using the instrument is that it was extremely interesting to work with. The assignment of the exact period of coincidence was to me a considerable difficulty at first, because one had to estimate between a flash which had occurred and disappeared and the next flash, and to estimate where the fiducial line lay with regard to the position of those two flashes. After a time it really became comparatively simple, and one could estimate it with an approximation to one-tenth of a second. With regard to the instrument generally, we found of course that there were certain drawbacks, but these were things that in most cases, at any rate, might be considered remediable. Perhaps we made rather much of the fact that the leakage of air seemed a little more than it ought to be, and we had to do a good deal of pumping which we did not like, except when we had the electric pump at the National Physical Laboratory to do the work for us.

Sir Gerald has referred to the flash-box, and at one period I certainly thought the flash box was going to be a very great trouble, and that was in the Magnetic Pavilion at Greenwich. Working there on one occasion when the little shutter refused to do its duty, I felt very sad about it. It wanted a certain amount of tickling to set it going, and this made me doubtful as to whether the point Sir Gerald has raised might not have been of very considerable importance, namely whether there might not be a considerable change in the lag between the period at which one estimated the first coincidence and at which one estimated the second coincidence. The fact that we had at Greenwich such consistent results seemed to me to prove afterwards that that was a trouble which had very little in it.

We had not the same excellent accordance in the observations at Cambridge. Sir Gerald has pointed out very clearly the extraordinary effect that time error has on the result. Time is the great trouble really in pendulum observations, so far as I can see: that (58×10^{-7}) is a figure that stares us in the face. I am not at all certain that I for one could determine, from a single set of observations, the time to within 2/100ths second; my friend Mr. Jolly might succeed. I do not think it is at all so simple, especially if the contacts with which one is working seem to suggest something of a rasping nature. The time question seems to be the matter that deserves most consideration, and I think that this beautiful

apparatus conceived by Sir Gerald and designed by Sir Horace Darwin, Mr. Mason and others ought to be capable of doing the finest work if we could be assured of having our times right and free of differential clock-rate.

I should like to ask Sir Gerald a question with special reference to Cambridge. Perhaps he or Mr. Hinks may remember that at the Conference of the International Geodetic Association in 1908 Sir George Darwin referred to attempts he had made to determine the rigidity of the Earth at Cambridge. It was in connection, I think, with work at Berlin, and I remember Sir George saying that there was something in the nature of the ground at Cambridge, some instability, which appeared to affect his work and that he had found it impossible to do what Berlin had succeeded in doing.

Mr. HINKS: George Darwin's work was long before that done at Berlin. I think it was the first work he ever did after he took his degree.

Mr. MCCAW: He had tried at Cambridge; Hecker succeeded in Berlin. I remember the mention of the fact at the London meeting of the old A.G.I., and I often wondered what exactly was the cause of the disturbance that prevented his observations from being fruitful.

[Probably the multiplicity of causes that affect pioneer work in delicate observations: a good deal had been learned in the thirty years or more separating the two experiments.—ED. *G.J.*]

Mr. H. L. P. JOLLY: After having experience of this apparatus I can heartily endorse Mr. McCaw's remarks as to it having been both very well *imaginé* and very well *réalisé*. Perhaps I am not quite so optimistic about the flash box. I must say that it would be a good thing if somebody led a revolt against the excessive use of electrical contrivances in apparatus designed to record instants or seize instants to a very high degree of accuracy. Every electrical contrivance, almost without exception, is also a mechanical one, and one only has to listen to a flash box to detect that the sound of the working is not always the same. One only has to do that to realise that little levers and so on which move about, and which are expected to do so in exactly the same way always to 1000th of a second, are not ideally suited to the purpose. What is wrong with the nimble ray of light which is so useful in experiments of this kind? I can see no reason why the thing which is keeping the time for you, if it is in the same room as yourself, should not be linked up with the apparatus by means of light rays with no possibility of any lag at all. I would very much like to see a chronometer modified with this end in view rather than a resort made to the everlasting electrical devices. I am sure they have a bad effect on the working of any timepiece; that is borne out when one sees the results that sometimes come from them. When we were attempting to use a chronometer with this apparatus we sometimes got, instead of the flash, a little shower of flashes running down the field of view. That is rather depressing. There is always a fascination in working with an apparatus which is designed to give such extraordinary accuracy as something like 1,000,000th of the thing you are trying to measure. In pushing the accuracy you come up against a blank wall, as it were. I think we can rest assured, from what Sir Gerald said, that the majority of the small influences which affect the work have been satisfactorily overcome; that is to say, we know what their values are. We are left with these two points: the main difficulty, as Mr. McCaw has said, is that the best time-keeper of all is the pendulum itself; the next best thing is the Shortt clock, which comes as near to being a free pendulum as possible. Then we have the chronometer which also gives an extraordinarily good performance, and it is interesting to note that out of one or two other things which have been suggested and used for getting time the tuning-fork has been suggested, and I believe experiments are being made in

America to use a tuning-fork as the standard time-keeper with which to compare pendulums in determining g.

There was another interesting suggestion made for a standard of time by Mr. J. E. Sears of the National Physical Laboratory, and that was a straight rod of steel which was maintained electrically in longitudinal oscillations and would go on so oscillating for all time. That suggestion has something in it, but I only mention it as being in the field as well as the chronometer and the astronomical clock. The main thing is the fact that we cannot get anything which keeps as good time as the pendulum itself.

The other way in which improvement can be made is the actual comparison between the time-keeper and the apparatus. I have just mentioned that I think the flash box leaves much to be desired, and, working on that difficulty, an idea suggested itself. It has been in the back of my mind for a long time. Perhaps if I unburden myself of it it may come nearer realization. It seems to me that the operations we perform are rather needlessly long. We have a chronometer which consists of a whole succession of wheels, and the excellence or otherwise of the chronometer depends in the last resort on its hair spring. We convert the mechanical oscillations of the balance-wheel into electrical impulses, these back to mechanical blows in the relay arm, these again to electrical impulses in the secondary circuit, finally obtaining a somewhat sticky mechanical movement in the flash box! If you can make a chronometer which keeps, say, within half a second a day, why not remove from the chronometer the essential thing and devise a piece of apparatus which is simply an oscillator controlled by a spiral spring? You can then make that piece of apparatus exactly like your gravity apparatus. If you do that you at once simplify the procedure of comparing the two together. I will indicate one form which the apparatus may take, but there is no finality about this suggestion for a design.

I would suggest that the gravity pendulum itself should take the form of a flanged wheel, the section of which would be quite ordinary except that it would be thickened up towards the lower rim, with the knife-edge in the centre. You can then make another exactly the same except that it would be quite symmetrical, and have its motion controlled by a spiral spring. The first is a gravity pendulum and nothing else. I would propose to determine the relative rates of these two by the so-called stroboscopic method. On the well-finished outer surfaces you rule a number of lines, say 500 to the inch, one set being slightly inclined with respect to the other. On superposing images of these you get the well-known shadow-band effect (like one fence going behind another). It would be very easy to observe these. Between and rather above the two discs would be a piece of glass transmitting light from one surface and reflecting it from the other. Your problem, then, in determining the coincidence is not how long it takes one pendulum to gain a whole swing on the other, but how long it takes for one to gain an angle equal to one 500th of an inch on the circumference. I believe if certain difficulties could be overcome it would be possible to do in five minutes what now takes an hour or forty minutes. I see no reason why the essential thing should not be removed from the chronometer and used to give the same thing as you now get from the chronometer as a whole, and if Mr. Hinks' useful flight of imagination bears fruit we shall be able to compare the simplified time-piece with the ticking of the clock at Greenwich. There are, of course, certain difficulties to be overcome because one is very dependent upon the amplitude in interpreting the shadow-band picture. If the amplitude and phase are exactly the same, then the shadow bands remain stationary all the time. If the amplitude of one is greater than that of the other but the phase is the same, the shadow bands move when the pendulums are in their neutral or

central position and they come to rest at the end of the swing and *vice versa*. I should not have the light going through the whole time, but arrange the pendulum to throw the beam of light only for a small fraction of a second as it passes through its neutral position, so that, with a scale in the eye-piece, you would see by how much the bands had moved on as the pendulum swung past each time. That is an essential simplification of gravity apparatus and one which seems to me to be within the bounds of possibility.

Mr. HINKS: During Sir Gerald Lenox-Conyngham's remarks with regard to the flash box an idea occurred to me that I have not had time to verify. I would like to ask Sir Gerald whether something could not be done with the Neon tubes which I think were invented by Dr. Aston at the Cavendish Laboratory during the war to study the motion of aeroplane propellers, and that type of thing. If I am right, Aston discovered that it was possible to make a flash with a Neon tube which was of the order of a 10,000th of a second.

Sir GERALD LENOX-CONYNGHAM: That has been tried. The idea was first suggested by Mr. C. S. Wright. He tried it when he was in Melbourne on his return from the Antarctic. The great difficulty is that for those Neon tubes you want about 250 volts. I have tried with induction coils and other plans, for you cannot pass such a voltage as that through the chronometer. You have to use some induction method. I have not been successful. The thing has worked for a minute or two, I have obtained perhaps a hundred flashes, and then it would fail. I have consulted several experienced people about it, but I have not succeeded in getting an arrangement which will work continuously.

Mr. HINKS: Of course it was intended merely as an auxiliary to the idea which you were kind enough to refer to: the suggestion I made about a year ago as to making the Greenwich clock tick perpetually for the whole world. Although the Astronomer Royal has not yet agreed that that is a desirable thing to happen, and I am not sure that at the present time the Hydrographer would be prepared to agree that the Greenwich clock should tick to the whole world, nevertheless I do feel the recent great development of short-wave signals sent off with very little power would make it extraordinarily simple, if not necessarily for Greenwich Observatory to do it, say for the Marconi Company at Chelmsford to have a Greenwich or Edinburgh clock permanently in their circuit and be sending out, as a regular standard practice, these seconds which would be useful, not only, I take it, for pendulum work but for all sorts of other laboratory purposes, and that if one got a Shortt clock thoroughly controlled, as they do at Greenwich or Edinburgh, transmitting short-wave signals, say, from Chelmsford, it would be a very useful thing.

In regard to the results that the Hydrographer has given us, I suppose I am right in thinking that when the Astronomer Royal made those experiments he selected, probably, his four best chronometers—anyhow, four good chronometers—and did the experiments in comfort at the Royal Observatory, which is rather different from having one or two being dragged about in the field. I think Sir Gerald Lenox-Conyngham would agree with that. So that although that result from Greenwich is very useful, it does not seem to me to throw any particular doubt upon the proposition that I am glad to find Sir Gerald supports, that some day we certainly must have the Greenwich clock ticking all over the world.

Mr. G. MANLEY: May I raise a point regarding the stability of the pendulums themselves? It has been said that the stellite which forms the knife-edge is a much harder alloy than invar, and that it is wedged into position when the pendulum is made. Does that create any molecular strain in the softer metal of the pendulum itself which may lead to some sort of change in the constants, so

that the period of the pendulum will not remain constant? My experience with brass pendulums at least suggest that rather curious changes of the kind are possible.

The PRESIDENT: If there is no one else who wants to contribute any comments I should like to ask one question, and that is, When this apparatus is in perfect order is there any programme in view for carrying out a gravity survey in this country? And if so, what are we trying to get at? Are we trying to get at the distribution of density in the crust, to discover the abnormalities, and so on? I take it we shall not any longer pursue the general figure of the Earth? That would perhaps be beneath the dignity of pendulum workers nowadays.

Sir GERALD LENOX-CONYNGHAM: I begin by answering Sir Charles Close, and I can say that there is, thanks to the cooperation of the Ordnance Survey and the Geographical Section of the General Staff, a programme before us, and we hope that it will be begun this summer. The observations made last year by Mr. McCaw and Mr. Jolly at Greenwich and at the National Physical Laboratory were a sort of first step in that direction. A more extensive programme had been planned, but there were delays owing, chiefly, to Mr. McCaw's unfortunate illness, and the smaller programme was substituted. We hope that this summer a real beginning will be made.

Now, Sir Charles asks the very fundamental question: What is it all about? Well, it is very important that one should know exactly what one is investigating, and I think that the distribution of mass in the Earth's crust is the object of our inquiry. At the present moment the Eötvös torsion gravity balance is being used by some members of the Geological Survey not far from Edinburgh, and I think the balance is now, so to say, beginning to come into its own. It was found such a very useful weapon for exploring areas which might prove rich in oil that the use for which its designer intended it, namely the study of the geoidal form, was rather lost sight of. That is, I think, now being taken up again. It may be of interest to mention that I had an inquiry a short time ago from a man in America who had experience of the torsion balance, and he said: "We want to be able to check the results of our torsion balance surveys by pendulum observations at intervals." It is very much the same as where you are surveying a piece of ground with the clinometer. You get the slopes and trace out the profile, but you like to have a few spot heights here and there to check the results of your clinometer. So to check the torsion balance with the pendulum is one of the problems. The two work together and both contribute to our knowledge of the form of the geoid. I think that is as much as I can say on the spur of the moment in reply to Sir Charles Close's question.

There are one or two other points. Mr. McCaw spoke of the ground at Cambridge having been found somewhat unstable by Sir George and Sir Horace Darwin, who worked together with the bi-filar pendulum. The effect of that sort of instability depends on the period of the vibrations which are set up, and I think the vibrations which disturbed their bi-filar suspension would probably not have any effect whatever on the half-seconds pendulum. I had a very interesting experience in my first season in India. When in Calcutta I found that I could not observe at all because the ground was so unstable that the pendulum after being brought to rest in a few seconds began to swing of itself. Not long afterwards I had to observe in Bombay, and the place where the observations were to be made was out at the Meteorological Observatory on the promontory called Colaba, which is fortified. To my great irritation I found that the time when I started my pendulum operations was the time that the gunners had chosen for practice with the heavy guns. I did not want to wait until they finished and they would not stop for me, so I determined to see what

happened. I set up the apparatus and just sat at the little telescope watching the reflection of the flash-box scale in the pendulum mirror, which was at rest when the guns fired. The firing of the guns shook the whole building I was in and nearly broke the windows, but there was not a movement in the reflection of my little scale. The pendulums were not affected at all. I think the vibrations that were so upsetting to the experiments that Sir George Darwin was making were of that nature and would not affect the pendulum in the least.

Then Mr. Jolly spoke of the disadvantage of having electrical apparatus intermediate between the chronometer and the flashes of light. I entirely agree. The old system of observing coincidences where you set up the pendulum of a clock and the gravity pendulum in one line and observed the two pendulums swinging, the one catching up the other, was very much more accurate than the present plan, but it was extremely inconvenient and difficult to erect. That was why it was given up. I recently had little mirrors attached to the balance wheel of the chronometer that I have and tried to get flashes direct from that, but I have not made a practical success of it as yet, though I am not without hope. I am sure if one could do that one would get rid of what I believe to be a fruitful source of error.

Mr. McCaw said that at Greenwich he came to the conclusion that the flash box was behaving pretty well. I dare say it was, but I do not think it always behaves very well. I have always suspected the flash box as being a source of error.

I was very much interested in what Mr. Jolly said with regard to comparing a gravity pendulum with a sort of pendulum controlled by a spring, but I have not quite understood whether he would trust to the spring-controlled pendulum to have a constant rate of oscillation or whether it would have to be connected in some way with a time-keeper. You see, one always gets back to the search for a period of which one can be sure to the millionth part of itself. The only thing we have at present is the rotation of the Earth, or perhaps we are getting to it in the Shortt clock, but nothing else that measures time seems to be constant to that degree. The period of most kinds of oscillation depends on the temperature; sometimes not only on the actual temperature but on the history of the temperature during preceding hours or days, and it is very difficult to get anything which is constant to the required degree.

As to the question asked by Mr. Manley: The strain set up by wedging the stellite knife-edge in the head of the pendulum is very small in comparison with the strength of the metal which has to bear it, and it does not appear probable that this moderate strain will cause any progressive change in the length of the parts affected. Moreover these parts are on the opposite side of the knife-edge from the bob of the pendulum, and so a change in their length would only have a slight effect on the time of the pendulum's swing. The sort of change that Mr. Manley has noticed in brass pendulums is, in my opinion, more likely to be due to instability in the joints between the parts of which those pendulums are composed than to molecular change in the metal itself.

Mr. JOLLY: Of course one would have to standardize the oscillator either whilst the experiments were being done or at frequent intervals, but its simplicity leads one to hope that it would be something which could be relied upon and need only be checked from time to time. If there were wireless signals which could be converted into visual signals, and that should not be impossible, it would be fairly easy to compare the thing just as one does a clock. But my idea was to make a rapid gravity survey going from one place to another. You would have in such an apparatus a fairly reliable means of measuring time.

The PRESIDENT: We are all very much obliged to Sir Gerald Lenox-Conyng-

ham for giving us this excellent paper. He and those who have been working with him have taken an enormous amount of trouble to provide the best sort of instrument possible for the work, and he has given us hope that we shall eventually have much material for further discussion. In your name and in the name of the Society I beg to thank him for his paper.

Mr. C. S. WRIGHT (Dept. of Scientific Research and Experiment, Admiralty) sends the following contribution to the discussion:

Sir Gerald is to be congratulated on his skill in design and on having realized the importance of a close link between the practical user and the apparatus constructed. The use of pendulums of low thermal expansion will make the difficulties of the observer much less than they were when I was a user.

In those days the timing of the coincidence interval at a field station was also likely to be subject to error, and I remember my horror on finding that the observations were less consistent in the period immediately following the winding of the clock. Under unfavourable conditions also the coincidence apparatus was inclined to behave badly, and my own preference is strongly in favour of using the light flash from a Neon lamp in the secondary of a transformer whose primary includes the clock "make and break." This has the great advantage that it should be possible by a small modification to operate the Neon lamp alternatively by wireless from a standard clock many miles away.

The problem of the regularity of operation of clocks and of the Earth's rotation is always with us, and I am inclined to think the time has come for a critical examination of the assumptions underlying this type of observation in which the time of swing of pendulums is compared at two places. The anomalies of gravity are surely a sign that gravity at any one place is subject to change, and indeed such changes are to be expected on other grounds. Especially if the two places of measurement are far apart with a considerable interval of time between the measurements, it seems to me that it would be wiser in the present state of our knowledge to swing two sets of pendulums simultaneously at the two places, followed by a second simultaneous measurement with interchanged apparatus.

A JOURNEY BY MOTOR LORRY FROM MAHALAPYE THROUGH THE KALAHARI DESERT

CAPTAIN THE HON. B. E. H. CLIFFORD, C.M.G., M.V.O.
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ALONG the eastern boundary the Bechuanaland Protectorate is bordered by the Limpopo River, which provides a perennial source of water; and further permanent supplies are obtainable at distances varying from 50 to 100 miles westward. Limited quantities of water are also obtainable in the small pans along the route from Molepolole to Lehututu, and from the latter place northwards to Ghanzi; but, except in the brief rainy season, there is not sufficient water on this route to do much more than meet the requirements of transport animals. As a consequence, it is impossible during most of the year to bring cattle from the pastures of the Ghanzi District to the markets in the east across the Kalahari Desert, which comprises the centre of the Protectorate. North of the Molepolole–Lehututu route already referred to, the Kalahari has been penetrated to a limited depth from Ghanzi in the west, and to a greater extent from Metsematluk in the south-east; and recently Dr. Mally, accompanied by Dr. Nobbs, motored from Metsematluk in a north-easterly direction about 20 miles beyond Chukudu.

The Protectorate Administration has been experimenting with various forms of desert transport, with a view to establishing watered routes across the desert. During the early months of 1928, while the rains were still falling, two expeditions were launched. Lieut. H. Beeching, of the Bechuanaland Protectorate Police, with camel and ox transport, set out from Ghanzi for the east, and pioneered a new route obliquely across the south-west corner of the desert from Ghanzi to Metsematluk. Heavy rains fell occasionally during the journey, and surface water was encountered in a number of pans, while in certain areas, mainly west of the Okwa River bed, a variety of desert melon, known as Tsama, was found in large quantities and provided drink and food for the oxen and camels. Before these pans could dry up an enterprising cattle dealer brought five hundred head of cattle out from Ghanzi along the route blazed by Lieut. Beeching. Almost simultaneously the Government despatched a six-wheeled Morris lorry from Serowe along the ox-waggon route, via the Botletle River, to Maun. The lorry encountered very heavy sand, and took seven days to reach Ngamiland. The return journey from Maun was made along the customary route which follows the Tamalakan and Mogogelo Rivers, the Mababe Flats, and the Chobe and Zambezi Rivers to Victoria Falls. Owing to the comparative absence of heavy sand, the outward trek, though considerably longer, was accomplished in four days.

These two expeditions provided much useful information, but to those responsible for the administration of the Protectorate it appeared that communication with Ghanzi would still have to be effected through South-West Africa, while the problem of providing a watered route for the export of cattle from Ghanzi eastwards was still unsolved. Moreover, the prevalence of tsetse fly along the recognized road from Maun to Livingstone rendered it necessary to explore the possibility of finding water along another route through the thirst lands east of the Mababe Flats, in order to maintain for Ngamiland the cattle markets of the Belgian Congo.

Such was the position at the end of May 1928, when, prior to his departure for Europe, the High Commissioner instructed me to organize an expedition to proceed from Mahalapye westwards across the unknown Kalahari direct to Ghanzi. By this time the pans had all dried up, and owing to the entire absence of water it was necessary to use mechanical transport.

The two lorries left Mahalapye at 2 p.m. on June 20, a day behind schedule time, as the Government lorry had to be fitted with a new generator and a special 50-gallon water tank. Two similar tanks were fitted to the lorry lent by the Morris Company, one containing water and the other petrol. All three were provided with taps which projected beneath the floor boards in an accessible position. About 150 gallons of water for the motors and for human consumption, and 320 gallons of petrol, were carried. It was calculated from previous experience that a minimum consumption of 4 miles to the gallon should be provided for, and as the total distance from Mahalapye to Ghanzi was under 500 miles, 320 gallons for the two lorries were considered ample to ensure a safe margin. Arrangements were made for further supplies of petrol to be sent from South-West Africa to meet us at Ghanzi. Water caused us some anxiety, as we anticipated from past trials that the motors working in low gear through sand would consume large quantities, but we hoped that one or two of the pans might still contain water. Mr. Grantham had improvised and fitted to his lorry a " Heath Robinson" condenser, consisting of a hosepipe connecting the radiator overflow with a 2-gallon petrol tin half full of water, through which steam given off from the radiator had to pass before it could escape through a small vent in the petrol tin. This device proved later on to be of inestimable value. Subsequently a similar condenser, which proved less effective owing to the absence of suitable material, was designed en route for the second lorry.

The party comprised the Imperial Secretary (in charge of expedition), Sub-Inspector Beeching (Protectorate Desert Officer), Mr. Grantham (Morris factory expert), Mr. Makin (South African Press), two chauffeurs, native corporal, native cook, three native constables.

Thus, in addition to tanks, water, petrol, petrol drums, tools, bedding and personal effects, rations, spare tyres and caterpillar tracks, there was a considerable live weight, and the lorries were heavily laden. From the experimental point of view this was necessary, as future desert transport will demand the traction of heavy loads across the Kalahari; and while it might have been easier and much more expeditious to effect the journey with light motor cars, the performance would not have provided us with the information we required.

Before leaving Mahalapye I tested my compasses for deviation by taking bearings of convenient stretches of the railway lines near Mahalapye, and in reducing magnetic bearings taken en route to true bearings I calculated deviation at 18 degrees west. The sun was just reaching the winter solstice, and throughout our journey the change in its bearing at a given time on successive days was almost imperceptible. At 4 p.m. the bearing was about 322 degrees magnetic, and every day during the desert trek the sun set within a degree of 315 degrees. During the latter part of the afternoon, therefore, it provided a valuable control, as a considerable mileage of our course after we left Kuke

was mainly north-westerly. At night I set a course on a star, checking the change in bearing about every half-hour, and selecting a new star whenever I was compelled to alter course to avoid dense bush or for other reasons. Sometimes these deviations from the general course only lasted for very short distances, and though for the most part they are plotted on the sketch-map, I occasionally found it better to reduce a number of bearings over short distances to a mean bearing for the total distance. Our course, as plotted over the 400 miles between Mahalapye and Sunnyside Farm showed an error of less than 3 miles in bearing and under 10 miles in distance.

The distance from Mahalapye to Lephepe of 79 miles by speedometer, over good hard country along comparatively straight spoor, showed an excess error of about one mile, but over the remaining 320 miles, where frequent bends had to be made to avoid trees, holes, etc., there appeared to be an excess error of 8 miles. I have accordingly reduced all distances over the latter section by 3 per cent. I have also distributed the small error in bearing in order to effect the slight adjustment necessary to make the position of Sunnyside, as fixed by my 400-mile compass traverse from Mahalapye, coincide with its position as shown on Capt. Stigand's map, G.S.G.S. No. 2988A of 1925.

Shoshong was found to be 24 miles from Mahalapye, whereas on the 1905 map, signed by Col. Panzera, the distance between the two places scales only 14 miles—an unexpected error considering the proximity of Shoshong to the railway line. Lephepe, though more accurately fixed, would appear to be farther east, while a comparison with Capt. Stigand's map will show a considerable difference in the latitude and longitude of Ghanzi. It is recognized that the 1905 map is very inaccurate, and in many places, notably Ngamiland, features have been filled in mainly by guesswork. Even the railway line has not been carefully plotted. Capt. Stigand's map, on the other hand, was found in the course of our journey from Ghanzi to the Chobe to be carefully compiled. I have accordingly taken the position of Ghanzi on Capt. Stigand's map to be correct. I had hoped to be able to fill in features of the landscape by intersection. Unfortunately after the first 50 miles no noticeable physical feature of any kind appeared to relieve the monotonous landscape. (Map follows p. 400.)

From Mahalapye we passed through grassy flats surrounded by hills, and sparsely wooded with knoppiesdoorn and thorn bush. Twelve miles out we rounded the spur of a long range and then passed through fertile country with black loamy soil, formerly the lands of the late Chief Khama, when his capital was at Shoshong, a large village 24 miles from Mahalapye, which we reached about 4 p.m. After passing Shoshong the soil became lighter and sandier, with patches of good dark loam, most of which showed signs of cultivation. Small kraals and occasional wells were encountered at intervals. We camped at sunset, having traversed 46 miles of excellent going, with occasional sandy patches. Outcrops of limestone gravel appeared at 47 miles and recurred at intervals until we debouched on to the huge limestone pan of Lephepe, 79 miles from Mahalapye, with water pits at the western end around which numerous herds of cattle were gathered to water. Here we found Lieut. Beeching's camels and took on water, as this was the last known supply. Just before sunset we left for Tsitle, which we reached after dark on

good roads. The tracks which we had hitherto followed became faint, and shortly after we left Tsitle I noticed that the course along which the native guides were conducting us was almost due north and therefore at right angles to our general direction, and I accordingly turned in a south-westerly direction, and almost immediately we struck heavy sand with low scrub, through which progress became tediously slow. I anticipated that, owing to the amount of low-gear work involved, considerable quantities of water might be used in the radiators if we attempted to traverse such country in the heat of the day, and I therefore decided to push on during the night. This practice was followed whenever possible throughout the journey across the desert, because, although the lorries rarely boiled even in very trying circumstances, we found it much easier to negotiate sand by night than by day. We also noticed that, even when there was no difference in the direction and velocity of the wind, there was far less dust by night than there was by day. In the two and a quarter hours from 7.30 p.m., when we left Tsitle, until 9.45 p.m., when we stopped for dinner, we travelled only 5 miles. At 11.45 p.m. we resumed, and I took over the wheel from Mr. Grantham. By 8 a.m., when we stopped for coffee, we had only added 18·4 miles, so that throughout the night of ten hours running time we covered a total of 23 miles, or 2·3 miles an hour. The night had been bitterly cold; the drinking-water had frozen in the water bags; and a conical piece of ice on the running board betrayed an otherwise imperceptible drip from the tap of a 50-gallon tank. Since leaving the deserted native village of Tsitle, the last vestige of former habitation, we had only penetrated 23 miles of desert after a whole night's dreary travelling, during which we averaged less than 3 miles to the gallon and used 25 gallons of water.

At 5 p.m. (June 22), when the worst heat of the day was over, we started off again through the same heavy sand, but had not gone far before the leading lorry, which owing to its newness was not pulling very well, was held up by a steep sandy ridge. We accordingly adjusted the caterpillar tracks and easily surmounted the obstacle. We found that the tracks not only helped us through the heavy sand, but also tended to reduce the number of punctures; though this advantage was to some extent discounted by the fact that we had to remove them before we could take off a punctured wheel. At 7.30 p.m. we halted for dinner. In order to economize time we had almost from the start confined ourselves to two meals a day. The first meal was usually taken about mid-day, when the heat of the sun raised the water consumption of the motors. It was followed by a brief rest, and between 4 and 5 p.m. the journey was resumed. We stopped for dinner about 9 p.m. so as to break up the long and weary night drive, which was undertaken in reliefs. The chauffeurs, when relieved from the wheel, usually managed to snatch an hour or so of interrupted slumber, before very long disturbed by shouts of "jack up!" from those on duty on the "front bench." This meant more punctures. The boys quickly kindled a feeble fire, which provided light for the detested operation of removing punctured wheels, laboriously gouging out of the covers sticks about the size of an ordinary lead pencil, mending the corresponding hole in the tube, pumping up and replacing the wheel.

On June 23 we encountered the first natives we had seen since we left Lephepe. The headman, a Bakalahari, came forward to greet us. His name

he informed me was Keli Kielwe, and his chief, Molandwe, resided near Molepolole. The kraal he lived in was known as Zuwe. Keli Kielwe said his people brought their cattle there to graze during the rainy season. They had already been transferred to more fertile pastures; only some goats remained. I inquired if there was any water about, and was informed that there was none. When asked how he obtained drink for himself and the goats, he replied that he did not drink anything and that the goats also did not need water. He added, however, that there was moisture enough in his desert food. I invited him to show me this food, whereupon he took a shovel from the lorry and led me aside into the veld. After searching for a while he indicated a dried-up looking creeper lying close to the sand, and resembling a piece of string. He traced it to the point where it entered the ground, and in a very few seconds he unearthed a root about the size of an adult's head, that on being cut open gave as much moisture as might be found in a juicy parsnip, which I was informed was ample for himself and the goats. I then noticed that his temples and his forehead had been lacerated and left patches of congealed and discoloured blood clotted on his face. I questioned him regarding this disfigurement, and was told that he had recently been sick and had scarred his features and rubbed in " medicine " to cure himself. In response to further cross-examination he explained that the medicine was obtained from the root of a rare scrub known as kunene, which grew near Molepolole. He burnt the root and rubbed the charred end into wounds made on his forehead and temples. He was not prepared to say anything definite as to the efficacy of the treatment; he was content to practise the remedies prescribed by his people, and for the rest, he said, he trusted in God. The uncultured African native who has not been subjected to Christian or Mohammedan influences does not believe in or worship a God. He reveres the ghosts of his ancestors, and strives to propitiate evil spirits, but before he came into contact with the white man he did not possess any theosophy worthy of the name. It is not surprising therefore that, unlike most primitive people, he does not worship idols or erect images. Theophany plays no part in the culture of even the most advanced Bantu, and in my opinion the Bakalahari are the most decadent of all Africans, not excepting the Bushmen, who, although subordinate to them, possess certain artistic faculties. I was therefore astonished to hear this ruffian speak of God, more particularly as his relations with the more civilized tribes were probably confined to a brief nocturnal visit to the villages on the edge of the desert for the purpose of selling skins. I accordingly questioned him regarding his conception of the deity, but my researches were abruptly terminated by the child-like logic of his reply—he simply stated that not having seen God he was unable to say what He looked like. Subsequently I interrogated him regarding the efficacy of the medicine, assuming that his God remained passive and showed no inclination either to frustrate or effect a cure. I gathered from the reply that he usually experienced momentary relief—no doubt due to distraction caused by the pain of the operation—but that the malady often became worse before it was finally cured. In all probability he was suffering from malaria, with complications which disappeared with the rainy season and the mosquitoes.

As we moved off it became evident that Keli Kielwe's religion was that of a

materialist. He was obviously agitated by the noise of the revolving machinery, and when asked to favour us with his impressions he replied that when he first saw the lorries he had concluded God must be changing his place of abode. On another occasion a bushman, who overtook us at a halting-place, stated that he had followed the spoor marvelling at the unusual pattern in the sand, and fully expecting to come across a huge serpent.

In the past the Bakalahari were tributary to the Bechwana tribes, in the same way as the Masarwa are said to be a tributary people to-day. Of recent years they have for the most part asserted their independence, and the Administration is encouraging the Masarwa to follow their example. In the course of an interview between certain Protectorate Chiefs and the High Commissioner last year the Chief Sebele assured Lord Athlone that his people no longer sent into the desert for tribute, but I availed myself of this opportunity to cross-examine this particular Bakalahari regarding his relations with the Bakwena Molanwe, whom he described as his chief. He replied that he was under no obligation to render service to Molanwe and was not required to pay tribute, but when he had a good (presumably rainy) season he sent skins to his chief in accordance with the custom observed by all native tribes. I asked him if he made a special journey to Molepolole for this purpose, and he answered that he went there to sell hides and skins, and took advantage of the occasion to pay his respects to the chief and present him with a skin. If he had a bad season he did not trouble to go to Molepolole, and I gathered that no explanation of his failure to appear regularly was necessary.

I then questioned a Masarwa who was standing by out of the hearing of the Bakalahari. He said he lived in Keli Kielwe's kraal, but was not subservient to him. He helped him when his cattle were at Zuwe, and received food in return. He had a Mangwato master, who lived near Serowe, whom he had left in order to visit some friends (bushmen) in this neighbourhood. He said his master did not object to his leaving, and he did not have to ask permission to go. I found it difficult to believe this statement, as all natives, of whatever tribe, are expected to ask permission of their chief or headman before leaving their place of abode, but though questioned closely on this point he adhered to his statement, adding that if he caught a duiker he would take the skin to his master, who might give him some tobacco in return. When asked where the friends he had come to see were, he replied that they had no particular kraal but lived everywhere in the veld. It did not follow that the desert was uninhabited because we had not seen any one. His people lived in the bush, and hid themselves when they heard us coming. They constructed small shelters for themselves and their families, but did not live in kraals. The Bakalahari lived in kraals, usually near the pans, but these were all dry now. If we met his people they might show us to the kraals and pans, but the Bakalahari might not like it. They were not, he said, the slaves of the Bakalahari, but were frightened of them. They sometimes worked for milk, but I gathered they spent most of the time hunting or doing nothing at all.

After we left Zuwe we passed through the tail of a belt of dense thorn bush on to an open plain where there was good hard going. The track on the second lorry had worked slack, and was inclined to flap about when moving over hard ground. It flapped so much that it knocked off the tap of the 50-gallon

water tank. Fortunately we discovered the disaster almost at once, but not before some gallons of our precious water had been lost. After sunset we passed through a small native village named Matapa, and then again struck very heavy sand. We continued to push on all through the night at a very slow pace over the worst going we had so far encountered. In places the ground was badly undermined, and we frequently fell into large holes dug by various animals. We only succeeded in covering 12 miles when at 3.30 a.m. we reached a small native kraal. It appeared to have been a cattle post in the rainy season. The sand, which had been bad enough in the open desert, was here destitute of the scant scrub which had afforded a helpful if treacherous surface, and was churned into a kind of desert sargasso. The country had been steadily rising and we appeared to have reached the summit, over which an icy wind was blowing. There was no vegetation in sight. Behind a palisade of sticks, which afforded meagre shelter from the blast, a few naked savages crouched around a tiny fire. We called upon them to show us the best way back on to the open veld. After much persuasion one of them preceded us, and I followed him until the lorry disappeared below the axle in what appeared to be the local ashpit. While the wheels continued to revolve we sank lower and lower. It was pitch dark. There was no alternative but to spend the remainder of the night in this inhospitable spot. As soon as a fire was made I threw myself down on the ground before it, and slept till dawn. The prospect was, if possible, more dismal than it had appeared overnight. We were on a small hill composed of cattle-dung and bleached bones, with a background of dirty sand. We extricated the truck and descended to a flat open plain, over which the lorries proceeded at a good pace. Limestone appeared, and within 3 miles we reached Kuke pan—a large limestone vlei with a pit excavated in it, from which the last drops of water had recently evaporated. It marked the intersection of our motor route with the chain of pans between Metsematluk and Ghanzi, which had been pioneered by Lieut. Beeching, and it looked as if water might be found comparatively close to the surface.

After leaving Kuke we passed through the thorn bush surrounding the limestone vlei in which the pan is situated into sparsely wooded undulating country with good grazing veld. Game spoor was plentiful, though very little of it appeared to be fresh. For 12 miles after leaving Kuke we continued to make anything from 10 to 20 miles an hour over a hard surface and through good pasture land. Then we again struck heavy sand, which continued until after we passed the village of Kukumane, which was reached about midnight. The village appeared, from the noises and fires, to contain a larger population than the few naked Bakalahari we had encountered at Zuwe and Kuke, though the natives, who left their fires to have a look at us, said there was no longer any water about and, presumably, they too relied on roots for the moisture they required. Some 2 or 3 miles out of Kukumane the surface and the veld again improved, and at intervals we passed deserted grass huts until we reached Kika pan. The pan itself was in the centre of a large crater-like depression, almost circular in shape, with steep sides. The surrounding country and the top and sloping sides of the crater showed no change from the general sandy soil of the desert, but at the bottom of the depression where the dried-up pan was situated limestone formation was exposed.

Women of Bushman tribe

Six-wheeled lorry used on the journey

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Sparsely wooded veld west of Kuke

Low scrub and sand west of Tsitle

The Ngaraga river

After leaving Kika the surface remained hard and the veld good. We sighted three enormous giraffe in a sparsely wooded plain. They were the first big game we had seen, and led us to hope that we might be nearing water. We headed in a more northerly direction so as to make Gomodimo pan, located by Lieut. Beeching on his camel trek earlier in the year. We were short of food, and, owing to the noise of the lorries, had sighted no game, so at dawn I went on ahead with a rifle and told the lorries to follow on after me. I had walked about a mile, keeping a very sharp look-out, when I detected something moving in the bushes some distance ahead of me and immediately took cover. It turned out to be a Bushman. It was evident that by chance I had seen him first, and as I was well concealed he came on in my direction without being aware of my presence. When he was quite close I stepped out from cover and hailed him in a friendly way, at the same time motioning him towards me. He was obviously surprised and a little afraid, but realizing that I was well disposed he came up to me. He was carrying a number of desert melons in his arms, which in the absence of water no doubt accounted for the giraffe and the big game spoor we had recently seen. I indicated the direction from which I had come and that in which I was going, and gave an imitation of revolving wheels to explain that vehicles were following. He made signs of comprehension and noises which gave the impression that he had no roof to his mouth. He was a dirty-looking specimen, naked but for a grimy skin pulled over his shoulders, and an even grimier skin round his loins. His scalp was shaved except for a narrow ring of short black curls, clotted together with dirt, which encircled his head and gave him the appearance of a diminutive monk who had deserted the cloister and reverted to primitive type. His nose was almost flat on his face, and his features repulsive, but his body and arms, though very small, were perfectly symmetrical. Continuing the pantomime, I pointed to the melons and to the direction from which he had come. I then pointed to the sun and described its course by a diagram in the sand. To my surprise he grasped my meaning, and indicated by signs that he had gathered the melons at a place in the direction from which I had seen him coming, which was two "suns" march away. I then made a miniature grass hut and with its assistance inquired where his kraal was. He waved his hand majestically round the horizon as much as to say that the whole desert was his home, and as I followed the motion I realized for the first time that we were surrounded by his family, who, reassured by the excellent relations we had established, had silently crept up without my noticing them, although the cover was very scanty. No doubt the country through which we had passed was inhabited by Bushmen. From past experience in South-West Africa I know that, when attracted by a buck being shot, they frequently appear mysteriously in what one might imagine to be an open and deserted plain, but in the absence of some such inducement they are often too shy to show themselves, even when the neighbourhood is literally infested with them.

As I glanced up at the new arrivals they suddenly became transfixed. I followed the direction of their gaze, but there was absolutely nothing to be seen, and to my untrained ears not a sound disturbed the impressive silence of the desert. But it was obvious that they had heard the hum of the approach-

ing lorries, which some time later I was also able to detect. Soon the two vehicles appeared over an undulation in the sand, and when I again looked round all my friends, with the exception of the father, had disappeared as mysteriously as they had arrived. When the lorries came to a standstill and the noise of the engines ceased small black faces appeared furtively from behind bits of scrub and tufts of grass, and with the aid of an interpreter I once more summoned them around me and inspected their general appearance. They all appeared to have recently overeaten themselves. It is their custom, whenever they kill a buck or rescue a carcass from the lions, to gorge themselves until they cannot possibly hold any more. Meat has much the same effect upon them as spirits have on a European, and literally drunk with food they lie down close to a small fire and fall into a state of coma from which even the flames fail to awaken them. I noticed that all my friends were scarred down the front of their bodies from the burns received after a recent debauch. Having learned from the interpreter that there was no water in the vicinity, but that we would find game and melon farther on, I was photographed with the family group and then we proceeded on our way.

About mid-day on June 26 the country began to rise, and we shortly found ourselves on the lip of another crater-like depression similar to that which we encountered at Kika. This was Gomodimo pan, and in the distance we could see the white of the usual limestone exposed on the far side of the hollow. Inspection through field glasses showed that a very little water still remained —the first we had seen since entering the desert, and, as experience proved, the last we were to find before again reaching European habitations. Round this meagre supply of liquid a number of enormous vultures were gathered, which flew off as some natives appeared on the opposite lip of the crater. We motored up and found they were native women carrying large numbers of ostrich eggs in skins slung over their backs. These they proceeded to fill with the muddy water left in the bottom of the pan. After they have filled the eggs they bury them in the ground inside their huts, and in this way lay up a supply of water sufficient to see them through the dry season.

The geological formation of Gomodimo pan was very similar to that of Kika pan. As you approach these pans the ground appears to rise slightly and then follows a local depression, on the floor of which the limestone is exposed. At Chukudu, which was the next pan we encountered, the natives had hewn a hole in the solid limestone at the lowest point, so that it served as a reservoir which was filled from the surrounding catchment during the rainy season. When the rains cease the water is gradually consumed or evaporated, while some of it no doubt percolates through the pores of the hard limestone. Farmers in the Ghanzi District subsequently explained that, when sinking their wells, they have to dig through this solid limestone for about 40 to 60 feet, when a bluish-white shale, apparently composed of a mixture of clay and limestone pebbles, is encountered. Through this it seems the water does not penetrate, and after digging into it for 10 or 15 feet a perennial supply of water is obtained. I was informed that in Ghanziland water was almost invariably obtained in these limestone formations. Indeed, I did not hear of any failures being experienced along the limestone belt.

Limestone outcrops appear superficially all the way along the route we

followed in Ngamiland and the Ghanzi District, and there is evidence to show that limestone is also present at varying depths below the sandy surface of the desert. The dry beds of the Okwa and Quale rivers appear to be a continuous layer of limestone, and the floor of the valley down which we motored after leaving Chukudu was composed of the same mineral. The formation at Kika and Gomodimo pans, which I have already described, and which in a lesser degree characterises the other pans, leads one to believe that a limestone substratum extends more or less continuously across the desert. If this theory is correct, and if the impermeable blue shale found at Ghanzi is also present, we should be able to obtain water at most of the pans we encountered.

The water found in these pans during the rainy season is unquestionably collected from local catchment areas, and no doubt the Ghanziland wells also obtain their water in the same manner. But if there extends beneath the surface of the desert a water-retaining formation such as I have described, it is conceivable that seepage from the Okovango marshes may, during the centuries, have found its way along this formation many miles into the desert. The boreholes sunk north of Mahalapye, in the Government quarantine camps, have not revealed the presence of limestone, and when water has been found it has been struck in a blue shale resembling Waterberg sandstone. Smith's Wells, in the same neighbourhood, are situated between two kopjes of Waterberg sandstone, and water has been exposed about 40 feet below the surface. The first limestone outcrops I noticed south of Mahalapye were at the small railway siding, Artesia, where the Rhodesian Railway Company struck a strong flow of artesian water at a depth of about 500 feet. From the train I noticed one or two similar outcrops farther south, but there was no solid limestone like that encountered in the Okwa River bed and the Chukudu Valley visible. It was merely limestone pebbles of varying size, mixed in the sand. At Lephepe the pan was a continuous white sheet of lime ground to powder, presumably by the cattle. Limestone is present in the neighbourhood of Mafeking and eastwards to Slurry, and I believe limestone outcrops occur at intervals from Slurry to Ghanzi and northwards to Ngamiland. The prospects of finding water along this route are encouraging, and I accordingly arranged with Mr. Marnewick, the owner of the farm Sunnyside, to sink a well at Dunkako pan, some 67 miles to the east and about 54 miles from the water supply at Van Zyl's Cutting, which though very limited lasts about seven or eight months of the year. Mr. Marnewick will commence operations as soon as possible, and if he strikes water at Dunkako he may be asked to sink another well in the Quale River bed 42 miles farther east. Other wells along the route might be at Gomodimo pan, 56 miles from the Quale River bed; Kika pan, 40 miles farther on; and finally at Kuke pan, 38 miles from Kika. From Kuke to the permanent water at Metsematluk is a distance of 53 miles. The Resident Commissioner is at present negotiating for the purchase of a boring machine which can be operated by a small petrol engine, as steam power is useless in the desert owing to the amount of water consumed and the absence of wood in many parts of the Kalahari. As soon as this machine is available it will commence boring for water at Kuke pan, and subsequently, if water is found there, work westwards to connect up with

Marnewick's party. I thought it advisable to select four or five of the most promising pans at intervals of about 50 miles, and to commence converging operations from the east and west. If water is found at the sites selected it will be possible to bring cattle out along this route at all seasons of the year. Ultimately wells will be required at more frequent intervals, but future policy will of course depend upon the measure of success achieved in the above programme. The interval between Sunnyside and Dunkako seems long in comparison with the others, but melon appears to be frequently met with in this area, and the grazing here is better than it is east of the Quale River. If we are fortunate enough to obtain good supplies of water in all the pans, wells might be sunk on other favourable sites in order that the grazing around them can be utilized and leased to approved tenants.

After leaving Gomodimo we passed alternating patches of dense thorn bush and open country. For 10 miles the going was quite good, but it became sandy again as we neared Chukudu pan, which has already been described. After leaving this pan and the small neighbouring village we motored down a shallow valley with a marked bank on the western side and a less conspicuous one on the east, which created the impression that it formerly marked the course of a river. Two or 3 miles farther on we turned out of the valley, leaving it on our right, and motored across an open plain with sparse stunted scrub until a very marked rise in the land brought us on to the saucer-like rim of another pan, called Kaotwe. The pan proper was at the easterly end of an extensive limestone vlei, around the edge of which we skirted, and turning in a more northerly direction we entered a flat treeless plain and saw a number of hartebeeste, gemsbok and wildebeeste grazing in the distance. On the other side of the plain, which was about 5 or 6 miles wide, we entered dense bush and encountered very heavy sand, which was quite as bad as the worst we had met between Lephepe, and Kuke. For 6 miles we crashed slowly through the forest, smashing down the trees small enough for the lorries to overcome, because any attempt to turn in the heavy sand so as to dodge the scrub resulted in the sand piling up in front of the oblique face of the wheels and seriously impeding progress.

On entering the hard limestone bed of the Quale River we motored along it in a north-easterly direction for about 2 miles, after which it commenced to curve round until we were going almost due west and appeared to join the bed of the Okwa River, of which I believe it is a tributary. Four miles after we first struck the Quale River darkness set in, and we resumed our north-westerly course. We soon appeared to leave the bed of the river, and immediately encountered close thorn bush and heavy sand similar to that through which we had struggled immediately before reaching the Quale. This thick bush no doubt marks the banks of the river, and probably when the river actually flowed it was dense tropical verdure. All through the night we drove at a snail's pace through heavy sand, stopping every now and again to mend the inevitable punctures. We had two or three hours' rest about 3 a.m., and at 8 o'clock once more descended into the valley of the Okwa River, having apparently crossed the intervening ground inside one of its huge serpent-like curves.

The general direction of the river was obscured by its winding course, and

in the absence of high ground from which to command a view of the surrounding country any estimate must be treated with reserve, but as far as I was able to judge, it appeared to have its source slightly north of east of our position and to have flowed on a bearing somewhat south of west.* The natives say that it has its source in a vast open plain in the heart of the Kalahari, which may conceivably be the so-called Anderson's Vlei, the existence of which had never been corroborated. I had hoped to be able to investigate these statements, but was prevented by shortage of petrol. The tsama melon which we had encountered near Kaotwe pan was very plentiful for 2 or 3 miles down the bed of the river, which resembled a flat open grassy plain. We left it by a steep rise, which was considerably higher than the one we descended when entering it, and from what I could see the west bank was much more clearly defined than the east bank. After leaving the river we travelled through open grassy bushland with sandy patches. It was attractive undulating country, which some miles farther on merged into an open plain, with excellent grazing and large quantities of melon, which I was told was an indication that heavy rain had fallen in these parts during the summer. We passed quite close to a large herd of gemsbok, and 8 miles from the river reached a limestone pan. About a mile farther on a sharp rise led us on to another flat pan, which looked as though it had held considerable quantities of surface water during the rains. Here we followed a very old native waggon spoor for some time, until I decided it had led us a long way out of our direction, and I changed course due west so as to counteract the error before resuming our usual north-westerly tack. We struck Dunkako pan at 12.40 a.m., and continued to pass through open grass plains providing, literally, millions of acres of good grazing, and encountered occasional herds of gemsbok and eland. The surface continued hard, though the grass clumps made it very bumpy in places. It became evident, after passing Dunkako, that our petrol supply, which had been causing us grave anxiety, would probably see us through.

The Tsama ceased just as we reached Gore pan, but reappeared later. About 17 miles from Gore we entered a shallow depression, apparently the bed of another dry river, along which we motored while it coincided with our general direction. Nine miles after leaving this river we encountered granite and sandstone outcrops—the first stone we had seen for nearly 400 miles, and we realized that we had at last left the desert behind us. Shortly afterwards we mounted the top of a low granite rise, and to our astonishment a brace of startled duck rose in front of us! They must have come nearly 200 miles from the swamps of Ngamiland, and probably 50 or 60 miles from the nearest surface water, and were disporting themselves in the deep trench cut out of

Note by Author, 12 December 1928

When I referred to the possibility that the Okwa might have flowed from north-east towards south-west I was influenced to give expression to this opinion because the natives told us that the Quale river joined the Okwa a few miles south-west of the point where we crossed the latter—see the relative positions of the two streams as shown on my map (*following p.* 400). But you will also observe that I have shown the junction of the two streams in a way which does not preclude, in such level country, the possibility of the Okwa having flowed sluggishly in a north-easterly direction. In spite of the view held in some quarters that a hollow depression connects the valleys of the Botletle with those of the Molopo and Nossob, I am inclined to think the country where I crossed the Okwa falls away to the north-east.

the solid granite, known as Van Zyl's Cutting, which, still about three-quarters full of water, confronted our gaze. This trench took its name from an old Dutchman who, according to our aged corporal of police, used to frequent these regions hunting elephant some thirty or forty years ago.

The 330 miles between Lephepe on the east and Van Zyl's Cutting on the west appear on the map as a complete blank. Across this space I had daily plotted our laborious course, anxiously computing the distance ahead of us and calculating whether our dwindling supply of petrol would see us through. On arrival at Van Zyl's Cutting the fuel and water nightmare was dissipated, for on a bush, close by the water in the cutting, fluttered a page torn from an ancient number of *Vogue*, and beneath this welcome sign of civilization were five drums of petrol! Less than 13 miles farther on we reached the farm Sunnyside, and had visions of fresh milk, eggs, butter, bread and other luxuries, but we found the place deserted, and subsequently learned the owner was absent at Maun. We pushed on for a few more hours, and then halted about 9 p.m. and treated ourselves to a night's rest.

At Gemsbok pan, the headquarters of the Resident Magistrate, we found fresh supplies of petrol sent from South-West Africa to meet us. We filled our tanks with petrol and water, and indulged in our first bath since leaving Mahalapye twelve days earlier, and then set out on our 500-mile journey to Victoria Falls, via Ngamiland.

At Dekar we called at a farm owned by a man named Talyaard. He spoke English quite well, and provided us with fresh milk, butter, bread and eggs. His wife wore a variety of white starched linen bonnet, and her features and dress were so characteristically Dutch that she might have stepped straight from a Flemish canvas. The manner in which they had maintained European standards in this lonely place, hundreds of miles from the nearest centre of civilization, excited my unstinted admiration.

For the most part we passed through open country, with patches of heavy sand, frequent limestone outcrops and occasional pans. There was heavy sand before we reached the kopjes, followed by a welcome stretch of flat loamy country through thick bush. Before reaching Lake Ngami the going was very heavy, but apart from some difficult patches the road was good all along the shore of the lake right up to Toten.

Lake Ngami is a vast expanse of rich black alluvial soil, upon which numerous herds of native cattle were grazing. They were magnificent, big-boned animals with enormous horns, and appeared to be constitutionally lean, but if crossed with thoroughbred bulls they might carry much more flesh. The northern end of the lake is usually inundated during June, July and August by flood water of the Okovango, and could, without doubt, be cultivated as intensively as Lower Egypt. Early explorers have seen the lake almost entirely flooded, and on one or two occasions during recent years, when exceptionally heavy floods have come down the Okovango, from one-third to one-half of its surface has been under water. The lake is entirely within the Batawana Native Reserve, and should be capable of supporting a large native population.

At Toten we crossed the bed of the Nghabe River, which had not yet come down in flood. The road, though sandy in patches, was generally good. It was full moon, and the scenery along the Ngaraga swamps and islets was

indescribably beautiful. After we left Gwangis Village we struck a few miles of heavy sand and crossed the Shashi spillway, which already contained 3 feet of water. The lorries managed to get through without difficulty, but we were only just in time, as it was rising rapidly, and a few days before our arrival had been quite dry. We reached Maun on Friday, July 6, and proceeded to arrange for the construction of a raft of native canoes to ferry the lorries over the Tamalakane River, which was broad and deep.

While I was at Maun I discussed with the resident magistrate the problem of establishing a fly-free cattle route east of the Mababe Flats, so as to enable us to retain the Katanga markets for our stock. The magistrate reported that the country east of the Flats had already been investigated, and the presence of limestone formation in places encouraged him to believe that water would be obtainable. In the circumstances, and as the journey had already occupied much more time than I could spare, I decided that it was unnecessary for me to undertake a personal inspection of this particular country. The total length of the deviation from, say, Mogogelo Drift to, say, Goha pan is in the vicinity of 100 miles. We passed very close to Goha pan on our way north, and although we did not stop to inspect it the natives informed us that it contained water. A narrow strip of dense scrub fringes the eastern edge of the Flats, and is infested with fly. According to the natives whom I questioned near Pudumatsanka the fly extends some distance beyond the limits shown on the map, but I gathered it ceased somewhere in the neighbourhood of 19° S. latitude. If this is so, it might be convenient for stock to return to the existing route somewhere between Ngunungu pan and the dry bed of the Savuti River, where we passed a couple of pans, containing water, and a native cattle post. Before I left Maun we were able to initiate negotiations for the construction of two wells on this deviation.

At Maun I interviewed Mathiba, chief of the Batawana, who is a charming and kindly fellow. I inquired regarding the affairs of his tribe. He informed me that the only thing that gave his people any anxiety was the spread of tsetse fly, which he said was very alarming. I gathered that it was already within 3 or 4 miles of Maun, but the most serious inroad was being made into the good grazing between Tsau and Maun, where it had extended nearly as far south as Makwelekwele. I told him that tsetse fly was common in many parts of the King's dominions, and that I would on my return make careful inquiries regarding the methods employed in these places to keep the fly in control. I explained that they did not inhabit places devoid of the shade provided by fairly dense bush, and suggested that he should organize regiments to burn and as far as possible clear of dense bush a broad strip of country between the swamps to serve as a buffer zone which should be kept free of cattle and game. I confessed it was a difficult thing to do, but I urged upon him the importance of keeping the fly away from the wooded area round Lake Ngami, which, if once invaded, would jeopardize the rich pastures on the lake itself.

After an amicable exchange of good wishes the chief presented me with a heifer for meat for my party. He asked me to convey his greetings to the High Commissioner, whom he looked forward to meeting, and we thereupon parted good friends.

I made arrangements with the Resident Magistrate for the purchase by the Government of six large mokoras for ferry purposes. They will be kept near Maun while the road across the Shashi spillway and over the Nghabe River at Toten is still open, but during the floods, when these crossings cannot be used, the mokoras will be available to effect a passage across the Botletle, where it joins the Tamalakane. This will enable waggons and motors to proceed to Ghanzi and South-West Africa by the road running along the east bank of the Nghabe, which, though very inferior to the Ngaraga road which we followed, is reported to be possible for motor transport.

We left Maun at 5 p.m. on Saturday, July 7. The road ran along the banks of the Tamalakane and Mogogelo Rivers, and was singularly beautiful, particularly by moonlight. The water was noticeably rising. A good hard road was provided by the grassy flats alongside the water. Some of the trees were stately in appearance, and dense Mopane forest extended eastwards on our right. I have crossed Central Africa from Dar-es-Salaam to the Congo, and have been hundreds of miles down the Congo River. I know the Rhodesias, and am familiar with the scenery of Zambezi and the Chobe. I have travelled extensively in the Union and South-West Africa. It may be that the contrast with the desert exaggerated the charm of Ngamiland, but I still feel that I have never seen more beautiful country of its kind in any part of Africa.

There was very little water in the Mogogelo River, and we crossed the drift without difficulty and passed through open sandy country where the going became rather heavy. The surface improved as we entered the fly belt, which we reached a little before midnight and stopped for dinner. We pushed on again about 3 a.m. through alternate patches of open grassy country and dense bush.

The surface continued hard until we reached the neighbourhood of the Kudumane River, which was dry where we crossed it as the floods had not yet reached these regions. We experienced considerable difficulty in getting over the Magwikwe sand ridge, though no doubt we could have negotiated it more easily had we adjusted the caterpillar tracks. The channel of the Kudumane River, which was dry when we crossed it, is narrow, with steep sides. The south-western face of the Magwikwe sand ridge rose abruptly from the edge of this sharply defined channel for about 80 feet. After this initial barrier was surmounted we continued to climb gently over very heavy sand, and then proceeded for about 2 miles across level undulating country. The descent into the Mababe Flats was almost imperceptible, and I formed the impression that the flats were appreciably higher than the channel of the Kudumane. We crossed the Magwikwe sand ridge again near Goha Hill, and after surmounting a similar initial steep face we appeared to traverse a sandy plateau about 10 miles wide before we reached the Kasinka Valley. With the exception of the narrow channel of the Savuti River, Capt. Stigand's map indicates that this ridge extends continuously from the point where it diverges from the right bank of the Chobe, near Kavimba, down to the south-west corner of the Mababe Flats. If this is so, and if the formation of the ridge throughout this distance resembles the specimens we encountered at the two crossings I have described, it constitutes a very formidable obstacle to the scheme for irrigating the Mababe Flats and Makarikari Flats advocated by Prof. Schwarz. In an

Root from which Bakalahari obtain water

Storing water in ostrich eggs at Gomodimo pan

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A Masubeia woman

Bushman mother and child

article published in the *South African Mining and Engineering Journal* of 3 December 1927, Dr. A. L. du Toit publishes a map showing a "Kandelay River" connecting the Chobe and Savuti (Sunta) Rivers. Down the dry channel of this river, which I presume is more or less identical with Capt. Stigand's Kasinka Valley, Prof. Schwarz proposes to divert the water from the Chobe required to irrigate the Makarikari Flats. I regret that I was unable, in the short time at my disposal, to search for the Kandelay River, but, although Prof. Schwarz gives levels to indicate its course, Capt. Stigand does not appear to have noticed its existence, and his map does not show it breaking through the continuous wall of the sand ridge. However, the sandy and occasionally undulating nature of the country which we traversed between the Mababe Flats and Goha Hill led me to conclude that the Schwarz irrigation scheme would be an expensive undertaking of considerable magnitude. I do not possess the technical knowledge to enable me to discuss these schemes but what I saw of the country inclined me to accept the view of the Union reconnaissance expedition that they do not appear to be of a practical or economic nature.*

The amount of fresh spoor we encountered indicated that lions were plentiful in these regions. A few miles after we entered the Flats we came across a kraal, and some Masubeia women and children came over to inspect us. Their men folk appeared to be away. They were small, but bigger than the Bushmen and differed in appearance from them. They had long instead of round heads, and agreeable features, which were pleasing to look upon after the flattened nose and, frequently, Mongolian countenance of the average Bushman. One of the young women whom we questioned had rubbed herself all over with a peculiar and, I was informed, expensive pigment, which gave her hair and skin an attractive reddish-brown hue. Their limbs, like those of the Bushmen, were elegant, and they were not disfigured by scarred and protruding abdomens. On the contrary, they were rhythmic in their gait, and appeared to be inordinately fond of dancing, as they frequently broke into a graceful measure as they walked. They repudiated the suggestion that they were servants to the Batawana, though I gathered from one woman that, during her childhood, she had had a Batawana master. Now, she said, she was married to a Masubeia husband, and she added that there were only Masubeia in her kraal. Formerly she had lived in the thorn bush on the edge of the Flats, but they had been obliged to move into the open because lions had attacked their village and carried off one of their number. The Mababe Flats appeared to provide excellent pasture, but we saw no cattle, owing possibly to the presence of lions.

After leaving the Flats we passed through Mopane Forest, with frequent open flats containing excellent grazing. We reached Ngunungu pan late

**Note from Memorandum dated 26 September 1928*

It is generally accepted that the marshes of the Okavango and the Chobe rivers with their connecting spillways and flood areas embrace an enormous expanse of country of a more or less uniform level. This is evident from the fact that a rise of a few feet in the actual height of the Chobe river is sufficient to flood vast areas in the Caprivi strip. When I visited Kasane in June 1926 the country between the Zambezi and the Chobe was for the most part submerged, although the actual rise in that river as shown against the steep southern bank near Kazangula (where the flood waters converge and might be expected to reach abnormal levels) was comparatively slight. The gently sloping rapids just below Kasane were still clearly defined.

Bushman mother and child

A Masubeia woman

Sunday night. There appeared to be a large native village, numerous dogs and cattle close by. The Mopane scrub played havoc with our tyres, and our progress was greatly delayed by punctures.

After leaving Goha Hill we struck heavy sand practically all the way to the Kasinka Valley. We stopped there for dinner and then pressed on all night, reaching Kachikau at dawn, after having been delayed by breaking a stub axle. That day we travelled beside the forest of tall reeds, three or four times as high as a man, which formed the marshes of the Chobe, and apart from some anxious moments when we sighted a large bush fire right across our path we reached Kasane, without incident, at 4 p.m. About 10 p.m. we resumed our journey, reaching Victoria Falls about 10 a.m. on Wednesday, July 11.

Motor transport can never be economically employed for hauling heavy loads across the desert until the puncture problem is solved. Solid rubber tyres do not seem to provide a solution, because they tend to bore into the sand instead of cushioning out on its surface like pneumatic tyres do. They might prove quite serviceable combined with caterpillar tracks, but the latter reduce speed, and should only be used on very rare occasions. I do not think they would be needed at all in sand, however heavy, if single balloon tyres were used in place of high-pressure tyres on twin wheels. Low-pressure tyres are unquestionably the best for sand, but they are supposed to puncture more readily, and in any case must be protected against stumps and the pencil-like sticks which caused most of our punctures. A single journey of 1000 miles, such as that accomplished by the expedition, destroyed, for all practical purposes, a whole set of covers worth £60. From the economic point of view this rules out motor transport of the desert; and when it takes eleven days to do 400 miles the gain over the ox-waggon is still further neutralized. But if a variety of flexible chain mail can be invented to fit over balloon tyres like Parsons chains, so as to protect both the tread and the walls, I feel sure that by substituting a single broad tyre for the present high-pressure twin tyres the speed will be increased, the puncture trouble removed, expense reduced, and the problem of desert transport solved.

Note by Author, 15 February 1929

It is quite as probable, in my opinion, that the Okavango Swamps, Lake Ngami, Mbabe Flats, the Botletle River basin, the Makarikari pans, and low-lying portions of the desert south of Rakops are features of a vast depression surrounded on all sides by higher ground. It also seems very probable that the watershed separating the source of the Molopo from that of the Crocodile (which can be traced in a north-westerly direction as far as Kanye, where it reaches a height of 5000 feet) extends farther westward through Lehututu, towards Gobabis. From this ridge a spur encircling the depression appears to run in a north-easterly direction through Fort Rietfontein (1200 metres), Ghanzi (1190 metres), Kobe (1090 metres), until it terminates in the hills along the south-east shore of Lake Ngami. If this assumption is correct (and it seems a more feasible one to me than Professor Schwarz's theory that the Makarikari and the Molopo are connected by a broad depression), the Okwa would flow in a north-easterly direction towards the Makarikari pan, that is to say in the opposite direction to that in which it appeared to me to run at the point where my expedition crossed it. This "enclosed depression" theory is of course purely speculative, but I have since learned that Dr. du Toit also supports it.

AN UNDESCRIBED LAFRERI ATLAS AND CONTEMPORARY VENETIAN COLLECTIONS

EDWARD HEAWOOD, LIBRARIAN R.G.S.

MUCH has lately been written about the great collections of Italian-made maps offered for sale by the publishers and print-sellers of Rome and Venice in the latter half of the sixteenth century, of which quite a number still exist in the same general form in which they were first put together. It was for a time the fashion, in part owing to Nordenskiöld's use of the term in his "Facsimile Atlas," to speak of such collections indifferently as "Lafreri's Atlas," whether they were actually brought together by Lafreri or not. A certain number deserve the designation from the fact that they begin with a finely engraved title-page with the imprint Rome (but with no personal name), and that in a general way the contents conform to Lafreri's own catalogue of maps on sale by him, a copy of which, still preserved, was reprinted by Ehrle in his memoir on Lafreri's plan of Rome of 1577, published in 1908. But other collections of equal importance were issued by the Venetian booksellers, very similar in general make-up but containing a large number of maps engraved and printed at Venice, many of which were actually borrowed by Lafreri for his own collection. On the other hand, certain Roman maps were taken over by the Venetians, either in their original form or re-engraved. It is therefore somewhat difficult to determine the relative importance of the two centres in sixteenth-century cartography, though the great name of Gastaldi, so closely associated with Venice, in itself gives that city a certain claim to priority.*

The recent acquisition by the Society, through Mr. Francis Edwards, of a fairly extensive series of such maps (eighty-eight in all, including plans of cities, etc.), with the rare engraved title-page above referred to, suggests a brief comparison of the more important sets hitherto described, together with a fuller account of the contents of the new acquisition. We understand that this volume was formerly in the possession of Mr. James Wyld, the cartographer, and for convenience' sake we may therefore term it the Wyld Collection, in distinction from that previously owned by the Society through the gift of Lord Peckover in 1905. Of previous contributions to the subject the following are the most important. The contents of a collection preserved in the Collegio Romano were listed by Castellani in 1876 in his catalogue of geographical works preserved in the library of that college. Later, Nordenskiöld, in his facsimile atlas, called special attention to the maps, giving in one list the titles of all items contained in the Collegio volume and in a copy owned by himself, now in the University Library at Helsingfors. He also reproduced a certain number of the maps themselves. In 1915 Dr. F. C. Wieder, who had examined an extensive set preserved in the King's Library at Madrid, discussed the subject comprehensively in the *Tijdschrift* of the R. Netherlands Geographical Society, and gave a valuable comparative table, showing in parallel columns the titles given in Lafreri's own catalogue, and the corresponding items in four of the most important sets then known—those at

*On Gastaldi see especially S. Grande: 'Notizie sulla Vita e sulle Opere di Giacomo Gastaldi,' Turin, 1902; Bagrov: "A. Ortelii Catalogus Cartographorum" (*Peterm. Mitt. Ergänzhft.* 199), Gotha, 1928. Bagrov has traced 109 separate maps due to him.

Madrid, Helsingfors, the Collegio Romano, and the Peckover volume in the Society's Library. Almost simultaneously (1914) Mr. Lea Phillips of the Library of Congress gave a full catalogue of the contents of a set acquired by that Library, comparing them with those of the Collegio Romano and Nordenskiöld sets and of one to be found in the Lenox Library. Those of Lord Peckover and Madrid were not known to him.

All the above sets have the engraved title-page and are thus probably of Roman origin, and it is only lately that a similar service has been done for sets not associated with Lafreri. A somewhat limited set of fifty-one items, some of them, however, of great rarity and importance, was carefully described by Messrs. Quaritch when offered by the firm for sale in 1926 together with a set of Lafreri's other great collection, the "Speculum Romanae Magnificentiae," dealing with the antiquities of Rome. The title of each map was given separately with mention of its occurrence or otherwise in certain of the Lafreri sets, and a useful feature was the mention in each case of the watermark of the paper used, which fully confirmed the Venetian origin of the collection, indicated also by the names of the publishers. A little later a much more extensive set, owned by the "Triester Lloyd," was catalogued and discussed by Prof. R. Almagià in *L'Universo* for March 1927 (see *Journal*, 69, p. 598). Here, too, the watermarks were carefully recorded. But one of the most extensive sets in existence—a volume of 161 maps (without title) acquired in the last century by the British Museum, has not yet been studied in detail, and its contents have been known to students at a distance only through the separate mention of the component maps in the printed Museum Map Catalogue of 1885. A preliminary attempt to analyse them broadly will be made presently. (Many of the same maps occur also in composite collections at the B. M., but none of these appears to be of contemporary origin.*)

It has been said above that certain of these collections seem to have come down in their original form. This is indicated in the first place by the general similarity of arrangement with the list printed by Lafreri, while a further piece of evidence is supplied, for several of the sets, by the marginal strips added to bring the maps to a uniform size. In the Peckover volume most of the strips bear the watermarks of the anvil (1924, No. 48†) or the crossed arrows (*ibid.*, No. 54), which are also to be found on many of the maps themselves (the anvil also on the title-page)‡. In the Trieste volume the mark of the siren (Fig. 2, No. 29) occurs on by far the greater number of the strips, and also on thirty-two of the maps, or nearly a fifth of the whole; and as every one of these thirty-two is due to a Venetian map-maker or publisher, there can be little doubt that the collection was formed at Venice. The

*Two other sets without title-page were briefly described by G. Caraci in the *Rivista Geogr. Italiana* for 1923 (vol. 30, pp. 273–280). Both were then at Florence, one in the National Library. Another important collection, mostly of Venetian maps, exists in the State archives at Turin (Grande, *op. cit.*, p. 42). Still others are described by W. Rüge in his series of Reports on old maps preserved in German Libraries published in the *Nachrichten* of the Göttingen Society of Sciences, 1904–16.

†References given thus are to the figures of watermarks in the *Journal* for May 1924.

‡Added margins of contemporary paper are to be found also in Lafreri's "Speculum." In three copies owned by the Victoria and Albert Museum the most common marks in such margins are Nos. 1, 15, and 32 of the present reproductions respectively.

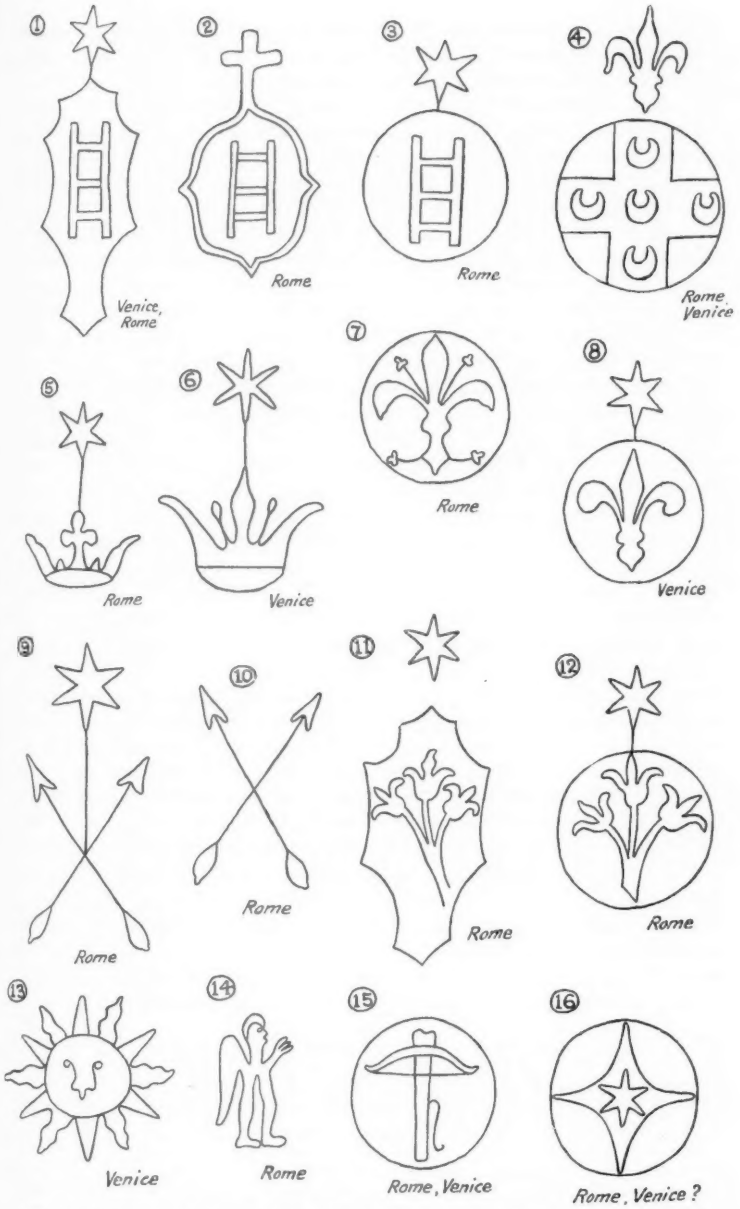


Fig. 1. Watermarks in Lafreri Atlas (Wyld copy). All reduced to half-scale

Quaritch volume is of smaller format, and the margins do not appear to have been similarly extended, though no information on this point is given in the printed list. Practically all the maps, however, are Venetian.

The British Museum volume is of a more composite nature, owing to what appear to be additions to an original more or less homogeneous set. This original basis can be traced pretty clearly, however, and forms about three-fourths of the whole. In this main portion the mark of the siren is again the most common, and with one exception (and that a contemporary mark used at Venice) is the only one found in the marginal strips.* As also the greater number of the maps are Venetian in origin, there seems little doubt that we have here too a collection mainly formed at Venice. Of the residue—representing apparently later additions—the greater part is made up of maps uniformly inlaid in *wove* paper, such as first came into general use towards the end of the eighteenth century.†

It is somewhat remarkable that nearly all the maps in the Wyld volume are inlaid in precisely the same way in similar wove paper (the exceptions are the large maps folded more than once, which have needed no addition). It might be thought that the B.M. volume had been made up to its present size by maps taken out of the Wyld set, were it not that many occur in both. It is difficult to guess at the date at which the wove margins were added, or where the work was done. In its present form the Wyld set is almost certainly in an English binding, for (1) it is labelled on the back "Ptolomy's Atlas"; (2) scraps of an English book (on the care of the horse?) are to be seen under the leather of the back. In the B.M. volume a fairly early date seems indicated for the wove margins by the traces of old folds due to a previous binding in a smaller format (the present one is exceptionally large), which run across maps and margins alike.‡ Even if the Wyld set was re-bound in its present form in the late eighteenth century, the presence of the title-page, the general concordance with Lafreri's catalogue, and the complete absence of extraneous maps or of any later than 1570, entitle it to be regarded as a true sixteenth-century collection. Although the covers are now loose the maps are in excellent preservation, and owing to the wide margins the format is considerably larger than that of the Peckover volume (the covers measuring $21\frac{1}{2} \times 15\frac{1}{4}$ inches), though not so large as that of the B.M. set in its present state.

To come now to the contents of the new acquisition. While many of the separate items are the same as in the Peckover volume, certain gaps in this are made good, while many of the maps are represented by different, often earlier, versions. The first page contains two maps—Ptolemy's World and a

*A rapid examination has shown that the Siren occurs on 37 of the maps and (by a mere coincidence) on 37 of the margins, but a still larger number of the margins, on which no mark is seen, are apparently of the same kind of paper.

†Wove paper is said to have been invented by the English printer John Baskerville about 1750. Part of his *Virgil* of 1757 was printed on it.

‡Some few margins are of late seventeenth-century paper bearing the initials of the Angoulême maker Claude de George, and the Dutch merchant Abraham Janssen; and as in one case at least this margin has not shared in the folding of the map, that folding might be thought still earlier. But a small supply of the CDG paper may have survived to a later date.

modern map of the northern regions—taken from one of Ruscelli's quarto editions of Ptolemy. They are out of keeping with the rest, but seem to have been included from the first, as they appear also in the Collegio Romano, Congress, and B.M. collections. No. 2 is Gastaldi's World on his oval projection, redrawn by Furlani in 1560 and published by Camocio at Venice.* It is also No. 2 in the B.M. set, while a re-issue of 1562 is No. 1 of the Quaritch set, and was reproduced by Nordenskiöld in his "Periplus" (p. 165). Of the various Italian copies of Lily's famous map of the British Isles (Rome, 1546) the volume contains those of 1556 and 1558, the latter certainly, and the former probably, produced at Rome. The former is sometimes spoken of as the Jesuit map, from the IHS and cross in the lower right corner. The fine map of Portugal by Statius, published by Tramezino at Rome in 1561, is present here though not in the Peckover set. A series of maps of the Netherlands, also due to Tramezino, are early copies of originals by Van Deventer, the maps being more often found in later versions printed both at Rome and Venice: examples from the two centres are strangely mixed up in most of the collections. Here they form a harmonious set (supplemented by Tramezino's maps of France and Belgium), whose completeness is broken only by the absence of Zelandia, which somehow is missing from all the more important Italian collections. Another rather rare item, due to the same publisher, is the fine map of Germany, with the mark of George Lily, which was reproduced by Wieder in Part I. of his "Monumenta Cartographica" (see *Journal*, 71, 188). Two maps of the Holy Land (Nos. 60, 61)—one made at Venice, the other at Rome—are present here though not in the Peckover volume, and the same is true of several plans of cities and fortresses, among which those relating to Malta and Valetta take an important place, the siege by the Turks in 1565 having just then brought the island prominently before the Italian public.

Like all these Italian collections, the volume is made up of maps originally issued separately at various dates, at Venice as well as Rome, but its Roman origin, already indicated by the title-page, is borne out by the fairly large proportion (as compared with other sets) due to Rome publishers, among whom Tramezino, as has been seen, takes an important place. It is rather strange that his Netherlands maps should still be found in a collection dating presumably from about 1570 (this being the latest date on any of the maps), since they had already been re-engraved by Lafreri in the 'sixties.† Another characteristic shared by the Wyld volume with others of the Rome sets is the importance given to the plans of cities, naval engagements and the like, this being a section in which Lafreri was rather specially interested.

As the Venice collections are made up mainly of maps, and even so show a total number greater than that reached by Lafreri's catalogue of maps, plans, and views taken together, they contain a good many items not found

*The dedication of this map is exactly copied on the small silver globe described in the *Journal* for May 1928, p. 480.

†As the title-page bears no publisher's name, there is no certain proof that it was first supplied by Lafreri rather than by another of the Roman firms, though the style of the engraving, and still more Lafreri's issue of a catalogue of the maps in 1572, lends strong support to the view that it was his.

in any of the Rome sets so far known, though the larger number is partly accounted for by the inclusion, sometimes, of two or three versions of the same map. On the whole, the contents of the Trieste and B.M. volumes are very similar, especially if we leave out of count the apparent additions to the latter, since it was first brought together. Of these additions, the maps with wove margins number about thirty. They consist almost entirely (there are but four exceptions) of maps produced certainly or presumably at Rome, the intention of the collector having evidently been to include Rome versions of maps otherwise represented by Venice productions. There are also a few extraneous maps of a different character from the rest, some small and unimportant. These two groups, with a few of the main group with margins or mounts of different (in part more modern) paper, make a total of about forty-three, leaving about 118 to be probably credited to the original collection. Of these about ninety occur in the same form in the Trieste volume, or differ only in the date of the imprint. In other cases the maps are practically the same, though from different plates, by different publishers. The agreement is reflected also in the relative frequency of the paper-marks, the most common in both sets, next to the Siren, being Nos. 19, 22, and 1 of the accompanying reproductions.

The following are among the more important maps found in both sets, but not, as a rule, in the Rome collections: Gastaldi's large map of Spain in four sheets, 1544 (T. No. 20, B.M. No. 16); a large map of Moravia, with imprint Vienna 1569 (T. 59, B.M. 66); Gastaldi's Moscovia—Venice, Bertelli, 1569 (T. 71, B.M. 50); reduced copies, made at Venice, of the Austrian maps of Wolfgang Lazius: of the seven in T. only two appear in B.M., but the latter has one ("Carinthiae Ducatus") which is not present in the former (T. 61–67, B.M. 60, 63, 64); a double map of (*a*) the Jura, (*b*) the Upper Danube, classed by Almagià with those copied from Lazius (T. 60, B.M. 68); Regni . . . da Venetia a Costantinopoli (Transilvania, etc.) (T. 68, B.M. 55); Greece by Gastaldi, Venice 1566 (T. 105, B.M. 130); Gastaldi's large map of Africa in eight sheets (seven only in B.M., as also in the Quaritch Collection, the missing sheet covering sea only) (T. 115, B.M. 144).

The following among other maps in the Trieste volume are not in B.M.: (No. 1) the heart-shaped World-map of Finaeus, as re-engraved by Cimerlinus in 1566; (No. 3) the original World map of Gastaldi, on his oval projection, 1546; (No. 6) his larger map of 1569, known only from two copies, embodying his revised views as to the relation of America to Asia; (No. 19) Lily's original map of the British Isles, engraved at Rome 1546 (the B.M. copy of this occurs in a separate small collection of maps of Britain); (No. 7) Tramezino's large World-in-hemispheres of 1554 (of this only the western half appears in a Rome set—that of Madrid); (No. 51) the rare map of Hungary by Sambucus, 1566; (No. 77) Laguna de Venetia; (No. 128) Monte Sinai by Fontana, published at Venice by Zalteri in 1569.

The following are items in the B.M. volume not to be found in Trieste, the list being swelled by the extraneous additions: (No. 2) the smaller Gastaldi World-map of 1560 (No. 2 of the Wyld set); (No. 22) Burgundiae Comitatus, N.V.A. formis, 1596 (paper-mark 43, 1924); (No. 56) Citta et Fortezze della Transilvania, etc., Venice, Zenoi, N.D. (mark resembling

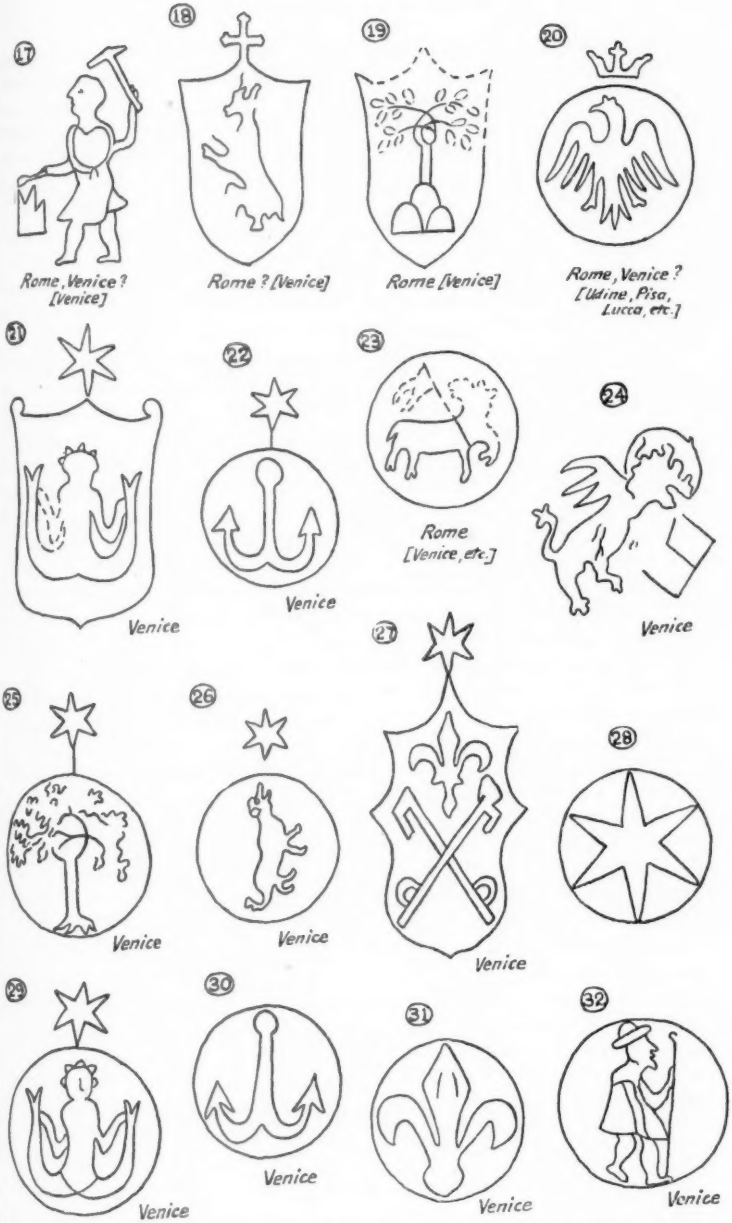


Fig. 2. Nos. 17–23 from Lafreri Atlas; Nos. 24–32 from Brit. Museum Collection, in which many of the earlier numbers also occur. All reduced to half-scale

No. 22); (No. 58) Anton Wied's Moscovia, the rare copy by F. Hogenberg, 1570 (mark of a French maker); (Nos. 111–113) Maps of South-Eastern Europe, all published at Venice, and two dated 1570 and 1571: one marks the principal sea-routes (marks: 20, 31?, and 22); (No. 141) Indiae Orientalis . . . N.P., N.D.—a finely engraved, rather small, map of Southern and South-Eastern Asia, with added margins of late seventeenth-century paper; (No. 157) Dutch map (by Plancius?) of northern South America.

One map that appears in all the more important sets—Mercator's double-cordiform, re-engraved at Rome—seems to be in an earlier state in the B.M. volume than in any of the others, as it bears the name of Salamanca in place of Lafreri.

The increasing number of such collections now being brought to light permits a clearer appreciation of the work of the Italian map-makers of the sixteenth century, and particularly of the relative importance of Venice and Rome as cartographical centres. For maps, as opposed to plans, Venice was certainly to the fore as regards originality, having to her credit the first publication of most of the important maps of Gastaldi. Original work published at Rome was for the most part of more restricted scope, concerned with local Italian topography, such as the well-known map of Tuscany by Bellarmato. As many of the derivative maps with no imprint may have been produced at Rome—the Venice firms having, it seems, been more careful in adding their names—it is difficult to gain a clear notion of the relative numbers to be credited to the two centres. Looking only at maps with imprint, we find a large proportion attributable to Venice, even in the collections with the Rome title-page. For the more important sets of both kinds the figures are roughly as follows, those for Venice being given first: Madrid, 46 to 33; Nordenskiöld, 33 to 14; Collegio Romano, 40 to 20; Peckover, 24 to 20; Wyld, 10 to 28; Library of Congress, 28 to 16; Trieste, 97 to 15; B.M. 89 to 26, or, if additions be omitted, 89 to 9; plans being omitted in each case. The Society's new acquisition stands alone in giving the lead to Rome, and this bears out the idea that the set may have been put together originally rather earlier than some of the others, before so many Venetian maps were available. In other cases the balance might perhaps be redressed if we could be sure of the provenance of the maps with no imprint. Some help might be given by a study of the paper used, but this cannot be entered into here.

Even for maps with imprint there may be a doubt as to the actual place of printing, from the possibility, considered by Nordenskiöld, that Lafreri acquired for his purpose some plates engraved at Venice. A particular puzzle is suggested by an important four-sheet map of "una gran parte dell'Europa" (i.e. Italy, Sicily and South-Eastern Europe).* In the S.W. sheet this is attributed to Gastaldi, and the general style agrees closely with that of his map of Italy, both being in fact engraved by Fabius Licinius of Venice. In most of the collections the N.E. sheet bears the imprint of Lafreri (1560), while in most of the copies examined the paper has a mark or marks more often

*In several of the collections the component sheets are placed in different parts of the volumes (in the Wyld set they are Nos. 29, 30, 33, and 54); in others they are mounted as a whole.

seen at Rome than at Venice. It is interesting to find that in the Wyld copy Lafreri's imprint is missing, suggesting that it was printed before the plate went to Rome. The mark on this copy (Fig. 2, No. 20) is found both at Venice and Rome, in about equal proportions.

That Lafreri set a high value on Gastaldi's work is shown by his issue at Rome of a version of that cartographer's large map of Lombardy, which is not to be found in either of the Venice sets above spoken of. He also had re-engraved the first sheet of Gastaldi's large map of Asia only two years after its first issue at Venice. Curiously enough, this Roman version is found in both the Venice collections, while the Peckover volume, with Rome title-page, has the original Venice version, as has also the Library of Congress set.

As we have spoken of the use in Rome of maps of Venetian origin, it is proper to mention other maps first made in Rome or elsewhere in the peninsula which were copied by Venetian firms. Examples of such are (1) the map of Switzerland published by Antonio Salamanca at Rome in 1555 (Wyld, No. 16), which was twice re-engraved at Venice, once with the original dedication to Iodoco a Meggen retained*; (2) Lombardia, published at Rome in 1558 by Vincenzo Luchini; (3) Tuscany, by Bellarmato, reproduced on a smaller scale at Venice; (4) the "Paese di Roma" or Roman Campagna originally issued at Rome in 1560 (Peckover, No. 45).

The following is a list of the maps and plans in the Wyld volume, only so much of the titles being given as may identify the maps by the help of the references to Dr. Wieder's list. The accompanying figures reproduce, on the scale of one-half, the watermarks found on the separate maps, so far as they can be deciphered, with a few which occur in the B.M. volume only.† The place-names in brackets denote other known occurrences of the marks. The numerals following each item of the list in square brackets refer to these figures.

CONTENTS OF THE WYLD COLLECTION

The leading words of the titles are printed here in Italic: the names following are those of a. the Author; b. the Publisher; c. the Engraver; then the place of publication, when known, and the date. The number in square brackets is that of the watermark: see pp. 361, 365. *The last number in the line is Dr. Wieder's serial number (Nederland. Histor.-Geogr. Documenten in Spanje, pp.* 128–49). *Numbers in brackets refer to corresponding but slightly different items in Wieder's list: the letters A and B following identify the map in the Wyld Collection with that in the Madrid or Nordenskiöld-Helsingfors set respectively.*

		Wieder
[Title] [11]	.. ..	—
1. *Ptolemaei . . .; Septentrionalium* [20]	.. ..	7
2. [*Oval World Map*] *a.* Gastaldi; *b.* Camocio; *c.* Furlani, 1560 [13]	..	—
3. [*Double heart-shaped World-Map (Mercator)*], *b.* Lafreri [4]	..	5
4. *Britanniae. c.* De Regibus. Romae 1558 [15]	.. .. ..	16

*A good many of the earlier Rome maps bear the imprint of A. Salamanca, who, as we learn from documents printed by Ehrle ("Roma prima di Sisto V," Appendice), in 1553 went into partnership with Lafreri for twelve years "per la stampatura ed il commercio delle loro stampe." The partnership was dissolved ten years later by an agreement between Lafreri and Francesco Salamanca, son of Antonio. The latter was responsible for a map of Greece found in most of the collections (No. 42 *infra*).

†A few others, from the Peckover volume, are figured in the *Journal* for May 1924 (Nos. 43, etc.).

5. *Hibernia nunc Irlant* [?] 13
6. *Britannia.* 1556 [10] 14
7. *Nomina in Anglia etc.* [14] 17
8. [*Coasts of Europe*] *b.* or *c.* Furlani. 1569 [21] 9A
9. *Francia, Spagna, etc.* 1554 [10] 18
10. *Hispania. b.* Zenoi 1560 [4] 19
11. *Lusitaniam. a.* Statius. *b.* Tramezino. *c.* De Regibus. Romae 1561 [9] 21
12. *Maiorica.* [None] 22
13. *Minorica.* [15] 23
14. *Galliae. a.* Ligorio. *b.* Tramezino. Romae 1558. [16] .. 24
15. *Gallia Belgica. a.* Ligorio. *b.* Tramezino. *c.* De Regibus. Romae 1558. [3] 28
16. *Helvetios . . . b.* Salamanca. *c.* Bossius. Romae 1555. [16] .. 54
17. *Galliae Belgichae.* Romae 1558. [12] 29
18. *Flandriae. b.* Tramezino. *c.* Bossius. 1555. [10] .. .. —
19. *Brabantiae. b.* Tramezino. *c.* Bossius. 1556. [3] .. .. —
20. *Gelriae. b.* Tramezino. *c.* Bossius. 1558. [10] .. .. .. —
21. *Hollandiae. b.* Tramezino. *c.* Bossius. 1558. [3] .. .. —
22. *Frisiae. b.* Tramezino. *c.* Bossius. 1558. [10] .. .. .. —
23. *Septentrionalium. b.* Tramezino. *c.* Bossius. 1558. [16] .. 35
24. [*Baltic, etc.* Anon.]* [16] 38
25. *Polonia, etc. a.* Castaldi. *c.* Licinio. 1562.* [15] 47A
26. *Germaniae. b.* Tramezino. 1553. [9] .. .. —
27. *Baviera. c.* Forlani. Venet. 1570. [1] 52
28. *Hungariae.* Romae 1559. [16] 46
29. [*Upper Danube, etc.*] [20] .. .. 53 (part)
30. *Gran parte dell' Europa. a.* Castaldi. [15, 17] 79
31. *Italia. a.* Castaldi. *c.* Licinio. 1561. [8] 55
32. *Regionis subalpinae.* [15] 65
33. [*Lower Danube.*] 1560. [20] .. .. 53 (part)
34. *Lombardia. b.* Lafreri. Romae 1564. [16] 66A
35. *Marca d'Ancona. b.* Luchini. Romae 1564. [4] .. .. .. (71)
36. *Tusciae. b.* Salamanca. [9] .. .. (73)
37. *Senae. b.* Ducheti. [19] 74
38. *Ilba* (*sic*). [20] 84
39. *Campagna di Roma.* Roma 1564. [17] 75
40. *Regno di Napoli.* Venet. 1557. [7] 77
41. *Sicilia.* [16] 80
42. *Graecia. b.* F. Salamanca. *c.* De Regibus. [7] 99A
43. *Napole. b.* Lafreri. Roma 1566. [23] 132
44. *Cirnus sive Corsica.* [20] 82B
45. *Sardinia. c.* Licinius. [20] .. .. (83)
46, 47 *Nomi della Italia. a.* Gastaldi. Venet. 1564 [6] 85, 86
48. *Melita ins. quam hod. Maltam . . . b.* Lafreri. Romae 1551. [16] —
49. *Melita nunc Malta, Li Porti.* Romae 1563. [2] .. .. .. —
50. *Nuovo citt*[a] *di Malta. b.* Lafreri. Romae 1566. [5] 141
51 *Isola di Malta, con li Porti . . . b.* Lafreri. Romae 1565. (North at top). [20] .. .. (87, S. at top)
52. *Forti di Melita. b.* Lafreri. Romae 1565. [20] .. .. .. —
53. *Isola di Melita e suoi forti. b.* Lafreri. Romae 1565. [7] .. .. —

*Nos. 24, 25 really form a single map, though they are mostly found separate.

54. [*Greece and Aegean.*] *c.* Licinius. Venetiis. [15, 16] 96
55. *Rhodus.* [15] 100
56. *Peloponnesus n. Morea. b.* Ducheto. 1570. [1] 93
57. *Corcyra, ante Scheria.* [None] 90
58. *Creta hodie Candia.* [None] 94
59. *Cyprus quae olim Macaria.* [None] .. .. (107)
60. *Nomina . . . Urbium Graeciae. b.* Lafreri. Romae 1570. [14] .. 101A
61. *Terrae Sanctae. b.* Ant. Sal. Exc. [3] .. .. —
62. *Palestinae.* Apud Ioannem Franciscium (*sic*) vulgo Della Gatta. 1557. [16] 112A
63. I. *Parte dell' Asia. b.* Lafreri. *c.* Bossius. 1561. [16] 105
64. *I Nomi . . . a.* Gastaldi. Venet. 1564. [6] 114
65. II. *Parte dell' Asia. c.* Licinio. [20] 115
66. *I Nomi . . .* Gastaldi. Venet. 1564. [6] 116
67. III. *Parte dell' Asia. I nomi. a.* Castaldi. *c.* Licinius. [20] .. 117
68. *Cuba; Hispaniola. b.* and *c.*? Forlano. [16] 119
69. *Peru* [*i.e. S. America*]. *b.* and *c.*? Forlani. N.D. [22] 120
70. [*Perpignan and Carcasona.*] E[neas] V[ico]. 1542. [12] .. .. —
71. *S. Quintino.* 1557. [12] 162
72. [*Fortezza di Gerbi.*] [15] .. .. (156)
73. *Bologna in Francia.* [3] 163
74. *Cales* [*Calais*]. [20] 164
75. *Fortezza di Ghines.* N.P., N.D. [9] 165
76. *Gravelinghe* [*battle*] [15] 167
77. *Antwerpiae.* [3] 168
78. *Thionvil.* [15] .. .. (170)
79. *Buda.* E[neas] V[ico]. 1542. [18*] 173
80. *Zighet. b.* Lafreri. Romae 1566. [23] 175
81. *Meraviglioso ordine Eserc. Turc.*† [1] .. .. (176)
82. *Venetia. b.* Zalteri. *c.* Forlani. Venet. 1566. [21] .. .. (128)
83. *Roma. b.* Lafreri. *c.* N.B. 1557. [19?] 123
84. *Hostia e Porto.* 1557. [12] 124
85. *Tripoli.* [With letterpress explanation below.] [3] .. .. 155?
86. [*Tunis and La Goletta.*] A.V. [?Aeneas Vico]. 1535. [22] .. .. —
87. *Vicovaro . . . ricuperato* 1557. Sebastianus f. [15] 126
88. [*Civitella* (title-space blank)]. [3] 134

*Mark very indistinct, but evidently to be taken for a stag, rampant (Briquet, No. 3338), which occurs also on a Venice map in the Quaritch set.

†A much larger plate than the corresponding item (No. 94) in the Peckover volume.

NATIONALITIES IN THE U.S.S.R.

J. H. REYNOLDS

EARLY in 1917 the Russian Academy of Sciences at Petrograd appointed a *Commission for the Study of the Racial Composition of the Population of Russia*. In 1924 the words *and Adjacent Countries* were added; and in 1926 *Russia* was altered to *U.S.S.R.* both in the name of the Academy and in the title of this Commission. Up to 1927 the Commission had issued two numbers of a *Bulletin* (*Izvestiya*) and thirteen numbers of *Travaux* (*Trudi*). The thirteenth number (1927) is a fifty-page *List of the Nationalities of the U.S.S.R.* compiled under the editorship of I. I. Zarubin by members of the Commission and various specialists. It is a valuable and interesting work. There are tabulated here no fewer than 169 nationalities, some of which however are very small, while others represent local branches rather than distinct peoples. (It may be noted that in No. 8 of the *Travaux*, which gives an elaborate scale of colour-signs to be used in maps issued by the Commission, 191 nationalities are represented by 113 different colour-signs). It is admitted that there was often insufficient material to determine whether or not an ethnical group should be reckoned as an individual unit, and that the list may have to be modified in the future.

With each nationality are given very brief particulars of its names (native and otherwise), numbers, distribution, language, religion, and economic activity, with any special characteristics in addition. It was originally intended to give a bibliography, but this idea had to be abandoned; it was felt particularly difficult to carry out in the case of peoples located partly inside and partly outside the Union. Insufficiency of space made it impossible to give the sources of the information on which the numbers of the various nationalities are based. Censuses of different years had to be used; in most cases the year to which a number applies is mentioned. In some cases it was only possible to give a round figure, and in some not even that. It was also found impracticable to observe complete uniformity in the other information supplied. With regard to nationalities which extend beyond the Soviet boundaries, only those are included which have more or less compact communities dwelling within the U.S.S.R. and reckoning it their native land.

Each nationality is inserted under its universally accepted name; then follow other names that are or have been applied to the nation, including native (*in italics*) and other appellations and tribal subdivisions, the whole being included in the alphabetical index at the end. To save space religious denominations are given not under the main groups, Christians, Moslems, etc., but only under subdivisions, Orthodox, Sunnites, etc. The following is a typical entry, under the Iranian group of Indo-Europeans :

> Kurds, *Kurmanj*, *Kyurd*, about 49,000 (1897). Essentially the nationality of Persian and Turkish Kurdistan; within the boundaries of the U.S.S.R. they live principally in the Azerbaijan S.S.R. and at various points in the Armenian and Georgian S.S.R.s (also in insignificant quantities in the frontier region of the Ashkhabad district of the Turkoman S.S.R.), leading a nomadic, seminomadic, and settled form of life and occupied with cattle-breeding, agriculture, and handicrafts (carpet manufacture). *Language :* the Kurmanji form of Kurdish in two dialects and numerous patois; literary languages,

Osmanli and Kurdish for ordinary use, Persian, Armenian, and Azerbaijan Turkish, according to the locality of habitation. *Religion :* Sunnites (principally) with a Japhetic sprinkling. The nomadic Kurds are sharply distinguished in type and character from the settled and semi-nomadic. They are divided into a multitude of tribes and families; a precise division would be into three essential groups.

This entry will serve to show the kind of information supplied. It is not possible here to give it for each group without translating the whole pamphlet. Appended, however, is the list of nationalities with their numbers. To save space, several small peoples have been here grouped together, though others have been left as they stand to show what minute nationalities have been taken into account. The ethnological grouping and terminology used by the Russians are interesting. The term "Japhetite" is applied to the Caucasian family and includes the Armenians ; as a religion it presumably refers to the Armenian church. The Palæo-Asiatic family does not amount to more than 33,000 ; three-quarters of this total are made up by three tribes living in Kamchatka.

It will be noticed that many of the dates are pre-Revolution, and it is not always clear whether the numbers given therewith apply to territories still within the Russian dominions or now partially outside. It would appear that Bessarabia is reckoned to be part of the Union. Kazakstan probably means the Kazak-Kirgiz Autonomous S.S. Republic.

I. INDO-EUROPEANS

A. *SLAVS*

1. Great Russians (1920)—

European Russia	52,213,322	
Ukraine	2,610,267	
N. Caucasus	5,631,851	
Siberia	7,097,699	
Kazakstan	1,581,691	
total		*c.* 70,000,000

2. Ukrainians

Ukraine (1926)	*c.* 22,500,000	
total		*c.* 25,000,000

3. White Russians	*over*	4,000,000
4. Poles (1920)		369,078
5. Czechs (1897)		43,054
6. Serbs		2,210
7. Bulgars (1920)		52,758

B. *BALTIC GROUP*

8. Letts (1920)	177, 616
9. Lithuanians (1920)	75,883

C. *IRANIANS*

10. Persians (1920)	*c.* 35,000
11. Irani (from Old Merv) (1920)	12,272
12. Tajiks (1924)	871,532
17. Kurds (1897)	*c.* 49,000
18. Yezids	*c.* 15,000

19. Talishes (1922)	75,824
20. Tats (1922)	125,000
27. Ossetians (1920)	227,630
13–16, 21–26. Ten small groups	*c.* 23,000
D. *OTHER INDO-EUROPEANS*	
28. Germans (1920)	1,044,371
29. Norwegians	300
30. Moldavians	*c.* 1,300,000
31. French (1907)	370
32. Albanians	*c.* 3,000
33. Greeks (1920)	171,061
34. European Gipsies (1920)	*c.* 28,000
35. Armenian Gipsies (1920)	2,500
36. Central-Asiatic Gipsies (1924)	*c.* 2,500

II. JAPHETITES

A. *JAPHETIC INDO-EUROPEANS*	
37. Armenians (1897)	1,126,594
B. *SOUTH CAUCASIANS*	
38. Georgians (1897)	1,094,734
39. Mingrelians (1897)	239,611
40. Lazes	*c.* 2,400
C. *CENTRAL CAUCASIANS*	
41. Svanetians (1920)	23,000
D. *WESTERN NORTH CAUCASIANS*	
42. Abkhazians (1897)	72,000
43. Circassians (Adige) (1920)	68,736
44. Kabardins (1920)	123,223
E. *CENTRAL NORTH CAUCASIANS*	
45. Chechens (1920)	181,257
46. Ingushes (1920)	58,370
47. Batsbians (1910)	1,945
F. *EASTERN NORTH CAUCASIANS*	
48. Dargins (1925)	*c.* 180,000
49. Kubachins (1886)	2,232
50. Laks (1920)	90,000
51. Avars (1909)	234,000
64. Lezgians (1920)	131,609
75. Tabasaranians (1920)	27,782
76. Kaitaks (1920)	21,609
52–63, 65–74. Twenty-two small groups	*c.* 106,000

III. SEMITES

77. Jews (European) (1920)	1,842,384
78. Crimean Jews (1912)	*c.* 7,500
79. Mountain Jews (Caucasian) (1897)	*c.* 25,000
80. Central-Asiatic Jews (1924)	22,842

81. Arabs (1924)	54,318
82. Aisors (Chaldeans) (1897)	4,701

IV. FINNO-UGRIANS

A. *WESTERN (BALTIC) FINNS*	
83. Karelians (1897)	207,728
84. Ijors (Ingrians) (1920)	10,595
85. Leningrad Finns (Ingermanlanders) (1920)	120,388
86. Finns (proper)	*an insignificant quantity*
87. Vepses (1920)	15,708
88. Vods	*c.* 1,000
89. Estonians (1920)	153,564
B. *NORTHERN FINNS*	
90. Lapps (1926)	1,620
C. *SOUTH-EASTERN (VOLGA) FINNS*	
91. Mordvs (1920)	1,167,537
92. Cheremisses (1920)	399,764
D. *NORTH-EASTERN (PERM) FINNS*	
93. Ziryans (1920)	186,108
94. Permyaks (1920)	128,132
95. Votyaks (1920)	466,182
96. Besermyans	*c.* 10,000
E. *UGRIANS*	
97. Ostyaks (1911)	18,591
98. Voguls (1911)	6,814

V. SAMOYEDS

99. Samoyeds (1920)	18,021

VI. TURKS

A. *CHUVASHES*	
100. Chuvashes (1920)	1,062,005
B. *NORTH-WESTERN TURKS*	
101–107. Seven small groups	*c.* 60,000
108. Karachais (1926)	46,230
109. Balkars (1920)	23,695
110. Kumiks (1925)	*c.* 160,000
111. Nogais (1910)	60,000
112. Mishars (1917) [*counted in Perm, Ufa, and Orenburg only*	185,568]
113. Bashkirs (1897)	320,743
114. Teptyars (1917) [*counted in Perm, Ufa, and Orenburg only*	289,571]
115. Volga Tatars (1920)	2,265,000
116. Kasimov Tatars	*no figures given*
117. Tobolsk Tatars (1898)	37,637
118. Siberian Bukhars (1897)	11,659
119. Barabins (1897)	4,433
120. Karakalpaks (1920)	96,976
121. Kazaks	*c.* 4,000,000

122. Chulims (1897)	11,123
123. Kirgizes (Qara Qirghiz) (1924)	643,099
C. *SOUTH-WESTERN TURKS*	
124. Gagauzes (1907)	76,266
125. Crimean (South-Coast) Tatars	*no figures given*
126. Azerbaijan Turks (1897)	1,506,540
127. Karapapakhs (1910)	8,000
128. Anatolian Turks (1897)	139,304
129. Turcomans (1924)	683,606
D. *SOUTH-EASTERN TURKS*	
130. Uzbeks (1924)	3,764,366
131. Kurams (1920)	*over* 50,000
132. Taraiches (Uigur) (1920)	62,303
133. Kashgarians (Uigur) (1920)	39,528
134. Chernev Tatars (1897)	6,342
135. Tomsk-Kuznetsk Tatars (1897)	8,164
E. *NORTH-EASTERN TURKS*	
136–145 and 147. Eleven small groups	*c.* 52,000
146. Yakuts (1917)	220,040

VII. MONGOLS

148. Buryats (1924)	220,442
149. Calmucks (*properly* Kalmiks) (1920)	*c.* 140,000
150. Sart-Calmucks (1917)	2,405

VIII. TUNGUS-MANCHUS

A. *TUNGUSES*	
151. Tunguses (proper) (1897)	53,194
152. Lamuts (1897)	9,049
153. Negidals (Amgun) (1897)	423
B. *MANCHUS*	
154–156. Three small groups (1897)	*c.* 10,000

IX. PALÆO-ASIATICS

A. *CHUKOT-KORYAK-KAMCHADALS*	
157–159. Three small groups	24,400
B. *YUKAGIR-CHUVANS*	
160–161. Two small groups (1901)	1,455
C. *OTHER PALÆO-ASIATICS*	
162–163. Two small groups	5,579
D. *ATTACHED TO PALÆO-ASIATICS* (*ESKIMO-ALEUTIANS*)	
164–165. Two small groups	1,635

X. FAR-EAST CULTURED PEOPLES

166. Chinese (1925)	57,167
167. Dungans (1917)	18,318
168. Japanese (1925)	588
169. Coreans (1925)	73,310

SOME MAP REPRODUCTIONS

FOUR MAPS OF GREAT BRITAIN, designed by MATTHEW PARIS about A.D. 1250. *London: Printed by order of the Trustees, British Museum* 1928. 16×11½ *inches; 11 pages and 4 plates. 12s 6d*

SIX EARLY PRINTED MAPS, selected from those exhibited at the Museum on the occasion of the International Geographical Congress. *London: Printed by order of the Trustees, British Museum* 1928. 17×13 *inches. 6s*

THE maps in these two volumes, issued to mark the visit of the International Congress, are already well known to students of cartography, who will, however, be glad of the opportunity of possessing them in well-executed reproductions at a very moderate price. Their publication should also widen the circle of those interested in the study of old maps.

The first volume contains what, apart from the Ptolomy manuscripts, are the earliest detailed maps of Great Britain; three of the Matthew Paris maps are preserved in the British Museum and one at Corpus Christi College, Cambridge. Beyond a slight reference to the possible influence of round world-maps such as the Ebstorf, the Editors, Mr. J. P. Gilson and the Rev. H. Poole, do not discuss the possible sources. They are nevertheless a fascinating subject. It is the custom to deride the cartographic value of these maps, without realizing that they were designed for a particular purpose: in spite, however, of a certain crudity, it is difficult to believe that they were drawn by Matthew Paris independently of other sources. It is evident from the most complete of these maps that it was specially designed to show one feature—the route from Dover to Saint Albans and thence to Durham. As this route is shown as a straight line, and the cities or stages, enclosed in prominent cartouches in the style of his 'Itinerary to Apulia,' are spaced out evenly, the distortion, particularly of the south and south-east coasts, is intelligible, and when allowance is made for this, it is apparent that Matthew Paris had a considerable knowledge of the coast-line of England. The backbone, as it were, of the map was doubtless selected because it was in the main the important highway of the kingdom, but it was modified by special circumstances: it diverges for example to run through Blyth and Belvoir, where there were Benedictine priories, the Order to which Matthew belonged. Scotland is not drawn in great detail, but there are three characteristics—a general easterly orientation of the peninsula, representation of the two Roman walls, and its almost complete severance from England, connected only by a bridge at Stirling. The easterly orientation is attributed by the Editors to the influence of a circular prototype, but a similar feature is characteristic of the Ptolomaic maps. On the other hand, the separation of the two countries would suggest that Ptolemy cannot have influenced the cartographer. It would, however, be of interest to know if the monastic library at Saint Albans possessed a Ptolemy manuscript. On portolans, the extension inland of the Firth of Forth and Clyde has been attributed by some students to a mistake of chart-makers in copying earlier portolans, but it appears on these Matthew Paris maps, drawn almost fifty years before the first dated portolan. It is more probable that it is simply an exaggeration of the actual topography, and an emphasis on the important position of Stirling.

The place-names on these maps, of which there are approximately 120, are interesting for their quantity. Those of inland towns definitely outnumber the seaports, which points to another source in addition to, or instead of, a conjectural portolan. The seaports, indeed, are by no means identical with those of the earlier portolans. Of the important centres of Benedictine rule in medieval England nearly half are shown by Matthew Paris, and a possible suggestion is that he gained his topographical knowledge in part at the pro-

vincial convocations of his Order which had been inaugurated half a century previously. He was also, for his time, a considerable traveller, having visited Scandinavia on monastic business. All the names on the maps have been transcribed and collated by the editors: they have, however, omitted to transcribe and emend the fragmentary transcription on one, which gives the sole precise geographical statement, to the effect that "Anglia" is 800 miles long and 300 miles in breadth from Dover to Saint David's. This is the nearest approach to a scale: on one unfinished map the scribe naïvely notes that he is unable to complete the drawing of England to scale through the limitations of space. Taking all these points into consideration, the Paris maps remain remarkable for their topographical knowledge and their richness in names.

The second volume of reproductions to be noticed forms to some extent a supplement to the first. One is Erhardt Etzlaub's map of the roads from Central Europe to Rome—"Das ist der Rom Weg"—a woodcut published at Nuremburg *circa* 1492. The roads are shown with broken lines, a scale of German miles is provided, and the points of the compass are indicated. Three routes cross the Alps, by the Semmering, the Splugen, and the Brenner. Rivers are drawn with a considerable degree of accuracy, though the representation of mountains is still rudimentary. The "Bohemian Quadrilateral," however, is conspicuously shown. A portion of Scotland appears in the lower margin, still with an easterly orientation.

The second map shows the progress made in British cartography in the three centuries following Matthew Paris. It is George Lily's map of the British Isles printed at Rome in 1546, in which the outline bears certain resemblances to the "Gough" manuscript map of the fourteenth century. The great improvement to be marked, however, is in the representation of Scotland.

The other maps are of varied interest. There is Blagrave's curious map of the northern hemisphere on a form of zenithal projection, little suited for one of its purposes, the delineation of Drake's and Cavendish's world voyages. Tatton's map of "Nova Francia," engraved by B. Wright *c.* 1610, shows the conservative style of cartographers—the representation of the coasts being reminiscent of the portolans—and combines the representation of the mythical islands of "Brazyl," "S. Brandan," "Bus Ins." etc., with the results of the early English and Dutch seekers after the North-West Passage. The diversity of authorities is evidenced by the heterogeneity of the place-names. An important map for the historical cartography of India, Baffin's "Description of East India" (1619), and N. Vischer's map of the east coast of America (1655), with an early view of New York inset, complete the volume. G. R. CRONE.

GEODETIC COORDINATES

FORMULES PRATIQUES POUR LE CALCUL DES COORDONNEES GEODÉSIQUES; Application dans le cas de l'ellipsoïde de référence international. By Lieut.-Col. E. BENOIT. (*Bulletin Géodésique*, No. 12, Oct.–Dec. 1926. 62 pages+1 form; No. 16, Oct.–Dec. 1927, 40 pages+1 form.)

AMONG the computational problems of practical geodesy there is none more familiar than the derivation of latitude, longitude and azimuth from the data given by triangulation. The common form of the problem involves the calculation of the latitude, longitude and reverse azimuth at the extremity of a line of the triangulation from the latitude and longitude of the other end, together with the azimuth at the latter and the length of the line; in other words, given distance

and azimuth, to find the latitude, longitude and azimuth at the outpoint in relation to the latitude and longitude of the standpoint. Starting, for example, from the Cape of Good Hope Observatory, with an azimuth observed therefrom, one may now compute the latitudes and longitudes of all the stations of a chain of triangulation through the African Continent as far north as Uganda. The formulae which are employed for this purpose are sufficiently numerous, if minor variations be taken into the reckoning, and to a considerable extent the development of methods has proceeded along national lines. If considerations of higher geodesy and mere variants are omitted, the methods employed are reducible to a category of three: (1) the difference of latitude, longitude and azimuth may be developed by Maclaurin's theorem in terms of ascending powers of the distance, the initial latitude and azimuth forming the arguments; (2) the calculation may be accomplished by successive approximation towards the means of the latitudes and azimuths at the standpoint and outpoint, these means when sufficiently approximate being utilized as the final arguments; or (3) the results may be reached through the solution of a right-angled spheroidal triangle. The first method was introduced by Legendre in 1787, developed by Puissant, extended by Levret, and finally carried to terms of the fifth order by Trépied of Algiers, Helmert, and Jordan. The second is the method of Gauss; it is well adapted to very short lines and is the method *par excellence* for the converse problem—the computation of distance and azimuth from the latitudes and longitudes of both extremities. The third is the method of Clarke and Andrae. The first is the basis of the forms used in France, India, the United States and several European countries; the second is in common use in Central Europe; the third has been largely used in the United Kingdom, the Dominions and Colonies, as well as in Denmark. We are here concerned directly with the first method.

From 1817 onwards the formulae of Puissant were utilized by the Ingénieurs Géographes for the latitudes and longitudes of the old triangulation of France, which was a national extension east and west of the Arc of Meridian measured by Delambre and Méchain at the end of the eighteenth century. The expansions were, however, limited to terms of the second order, with the result that errors up to 2 metres were introduced by the computation. Since the old triangulation fell far short of the desirable from a modern standpoint, these errors were only additional to errors of somewhat the same order in the triangulation itself. With a view to their removal, however, Hossard introduced the terms of the third order and prepared tables to facilitate the calculation of these small terms. His expressions were not very neat, and on the new Meridian of Paris formulae derived from those of the *Principal Triangulation of Great Britain and Ireland* were employed, Clarke's spheroid of 1880 being adopted as the Figure of Reference. According to General Georges Perrier, editor of the *Bulletin Géodésique*, these derived formulae, preserving the terms of the fourth order, have revealed themselves like all those of the same type, as of a precision excessive for sides of triangles of normal dimensions, while at the same time giving rise to long and complicated calculations. It should be noted here that the method of precision published by Clarke in the 'Principal Triangulation' is not that which is commonly known as Clarke's method; the latter, to which reference has already been made, is described in his 'Geodesy' and is one of the simplest methods in use to-day, giving at the same time a high degree of accuracy.

In the two numbers of the *Bulletin* which form the subject of this review, General Perrier publishes formulae devised by Lieut.-Col. Benoit in 1905 and employed in Cochin China. These formulae revert to the expressions of the

Ingénieurs Géographes, but amend them in two respects. In the Clarke method in common use the preliminary argument for the tabular function, here P, which involves the radius of curvature of the meridian, is the initial latitude; but this is used merely for the purpose of finding a sufficiently accurate value of the mean latitude to give the value of P for the true mean latitude. The factor Q, which in the Puissant expansion corresponds to the " spherical excess factor" required for Clarke's method, and the factor R, which involves the radius of curvature of the spheroid in the direction perpendicular to the meridian, are taken out by Clarke for the "foot of the perpendicular," whereof the latitude ordinarily differs by some seconds only from that of the outpoint. Save for Q, the arguments employed by Col. Benoit are nearly the same as Clarke's. From this point the two methods diverge, Clarke obtaining the corrections in the form of spherical excesses, Benoit in the form of corrections to the logarithms of his last-computed terms. Avoiding the Lagrange method of expressing the remainder in Taylor's or Maclaurin's series, the author includes the third-order term for the difference of latitude δL in a correcting factor $(1+\alpha)$ multiplying the second-order term. He finds accordingly that the correction involves δL as a simple multiplier of an expression which is tabulated in Table II. In the United States the expansion of Puissant for the latitude is used directly with the initial latitude as argument, but Hayford introduced a "correcting term," not however to the logarithm, and retained Puissant's term of the third order. The Indian formulae, developed by Everest and Walker, already contained the correcting term and preserved the third-order terms of all the Puissant expansions. Col. Benoit, after tacitly verifying the truth of Dalby's theorem, finds that the corrections to his formulae for the differences of longitude and azimuth are each expressible as two small terms; but he increases the simplicity by showing that all four terms may be taken from a single Table (III), though three arguments are required.

So far Benoit's method has been compared with that with which Clarke's name is usually associated. But it should be remarked that, on pp. 252–3 of the 'Principal Triangulation' (1858), Clarke gave other expressions for use "when the distance s does not exceed 40 to 50 miles." These bear a very much closer resemblance to the method of Benoit, though the small terms introduced by the latter are apparently somewhat more accurate. It may be added that the small corrections to the logarithms of the first-order terms in this Clarke method of 1858 are practically the developments of the spherical excesses which were used to correct the angles in the Clarke method of 1880—a remark which applies also to the expression for the convergence.

In the Benoit method, 8 tabular factors must be extracted from 5 tables; in the Clarke method of 1880, 4 factors from 3 tables. In America the formulae involve 7 factors from 7 tables; in India, 11 factors from as many tables.

The author states that the maximum error on a line 100 kms., say 60 miles, long is 0·002 second of terrestrial arc; thus the old error of $2\frac{1}{2}$ metres is reduced to $2\frac{1}{2}$ inches, even in latitudes up to 70°. The figures are verified by comparison with the results derived from the more precise expressions of Andrae.

The tables have been computed by M. Périn, the logarithms being given to 8 figures. The figure of reference is the Hayford Spheroid. No. 12 of the *Bulletin* gives the derivation of the formulae and the appropriate tables on the sexagesimal system, while the tables in No. 16 are computed for workers using the centesimal division of the quadrant.

The formulae are a noteworthy improvement on the indolent methods of the Ingénieurs Géographes. G. T. McC.

THE ANCIENT WELLS, SPRINGS AND HOLY WELLS OF GLOUCESTERSHIRE: their legends, history and topography. By R. C. Skyring Walters. *Bristol: St. Stephen's Press* 1928. 9×5 *inches;* xiv+194 *pages; illustrations and plans.* 12*s* 6*d*

What Dom. E. Horne has done for the Holy Wells of Somerset, Mr. Walters successfully essays to do for Gloucestershire. It is a very attractive, semi-popular subject. The pin wells, St. Agnes Well, St. Mary's Well, Nun's Well—the wishing, haunted, and medicinal wells—the beautiful well-heads—the associated memories of primitive, Roman, and mediaeval times—the customs of sacrifice and floral decoration—these and many other suggestions rise at once at the mention of the title. Dr. Headlam, Bishop of Gloucester, contributes a foreword. The author has diligently put together the scattered history of the holy wells of Gloucestershire, their traditions and ancient customs, describing the ancient springs as they now exist, their locations, their present names (often modern ascriptions), and what they imply. Apart from giving pleasure to the reader, this record may help towards the preservation of these sources. How apt they are to become obscured! Horace's "O fons Bandusiae" is quoted (p. 2) with a wrong division of lines.

A FAMOUS CORNER OF TUSCANY. By Evangeline E. Whipple. *London: Jarrolds* [1928.] 8×5 *inches;* 320 *pages, and illustrations.* 15*s*

Though Mrs. Whipple scatters a number of pictures of the Bagni di Lucca, which she clearly knows well, and of the neighbourhood up and down her book, this really resolves itself into an account of the most famous visitors to these baths, which have been frequented for the waters from very early days, and she gives us sketches of their lives in considerable detail. So far as the Bagni di Lucca are concerned, Montaigne, who had a mania for drinking waters, is the most interesting of them. He has left an admirable account of his sojourn and of the social life there. Among English visitors the Old Pretender is not the least important. His visit created a considerable stir, and he even touched for the King's Evil. Mrs. Whipple has spared herself no pains to make her stories of the visitors as accurate as possible; nor are they lacking in variety, seeing that they range from the Countess Matilda of Tuscany and the Emperor Frederick II., Shelley, Montesquieu, and Carducci, to the Brownings, Charles Lever, and Marion Crawford, who was born there. The book is well illustrated.

L. C.-M.

LA ROUMANIE ÉCONOMIQUE. By Georges D. Cioriceanu. *Paris: M. Giard* 1928. 10×6 *inches;* 444 *pages and illustrations. Francs* 125

LES GRANDS PORTS DE ROUMANIE. By G. D. Cioriceanu. *Paris: M. Giard* 1928. 10×6 *inches;* 82 *pages, and plans. Francs* 25.

These volumes form part of a series of works by the same author dealing with the economics and geography of Romania. Accordingly, the story of the country's economic evolution in the first-named breaks off at 1915, and is to be resumed in a later volume. The interest, therefore, lies mainly in the picture presented of the state of affairs at the union of Walachia and Moldavia in 1859, and of the progress made towards westernization.

The dedication to de Martonne shows that the author has been impressed by the necessity of showing the geographical background to the economic changes, and the opening chapters give a summary of relief and structure, climate, soil and natural vegetation, based to a considerable extent on de Martonne's work. The chapters following deal with population, production, communications,

tariffs, commerce, and national debt, though the tiresome arrangement of the subject-matter into three main divisions, corresponding to the three periods 1860–1881, 1882–1900, 1901–1915, means that each of these aspects is treated three separate times, with consequent repetition and break of continuity. All three sections, however, emphasize the rapid changes which took place during the period. The year 1859 saw the "United Principalities" freed from the menace of raids and Turkish impositions, but with a population crushed by years of ill-usage, and with its chief wealth unexploited. The whole country had a strong oriental colour, with its few small insanitary towns, and a marked lack of the machinery of "western" life, *e.g.* the first bank of any size was only founded in 1857 and was a failure; the first railway was opened in 1869; even the humble potato was unknown in Romania in 1860

The institution of the International Danube Commission in 1856 had a great deal to do with the rise of Romania as a leading exporter of grain. Up to that time stock rearing had been the chief pursuit, and the *bordêi* (pit-dwellings) of the lower Danubian plain reflect the dangerous nature of these open lowlands. The new era allowed these plains to be cultivated in peace, the new railways allowed the grain to be hauled to the Danubian ports, and the improvements in the navigability of the Danube allowed the grain to be sent via the Black Sea to markets in Western Europe.

'Les Grands Ports de Roumanie' deals with the development and present-day traffic of the Danubian ports and of Constanța. In spite of the extension of the Romanian coast-line with the acquisition of Bessarabia, there are no additional great ports, nor suitable sites for their establishment, the typical lagoon and sandspit coast only allowing the entrance of vessels of shallow draught, *e.g.* 6½ to 7 feet in the lagoon at the mouth of the Dniester, as against 23½ to 27½ feet at Constanța, 21 feet at Galatz, and 14½ feet at Brăila.

The Danube remains the chief line of entry for shipping, although Constanța has a greater amount of traffic than any single Danubian port, and her traffic is growing more rapidly than that of any of the river ports.

The presence of the two ports of Galatz and Brăila within 9 miles of each other is to be explained by their being rival ports before the union of Moldavia and Walachia, and their actual sites are determined by the absence, at those points, of the lagoons which usually fringe the left bank of the lower Danube. The development of both, however, received a check with the extension of the European railway net to Romania, and they again lost in relative importance with the construction of the railway across the Danube to the ice-free port of Constanța, and with the great improvements at that port which amounted to the construction of an artificial harbour.

Constanța leads both in imports and exports, the average for both reaching 19 per cent. of the totals during the quinquennium 1922–26. Corresponding figures for Galatz and Brăila are 13 per cent. of the imports and 15 per cent. of the exports for the former port, and 6 per cent. of the imports and 14 per cent. of the exports for the latter. (It must be noted that both volumes abound with misprints, and it is with difficulty that the figures in the different tables can be reconciled.)

Taken as a whole the traffic handled in 1925–26 was slightly above pre-war figures, but it is clear that the new provinces do not in the main send or receive their goods via the Romanian ports (pp. 59 and 69). Pre-war tendencies have already been resumed at all ports. Constanța's chief exports continue to be petroleum (76 per cent.), grain (18 per cent.), and timber (4 per cent.), while Galatz sends out timber (*c.* 50 to 70 per cent.), and grain (*c.* 20 per cent.), and

on Brăila's export list grain has no near competitor. Sulina (administered by the Danube Commission) remains chiefly a port of transhipment.

For their fullest development the Danubian ports need better communications, in particular with Bessarabia and to a less extent with Transylvania. The Prut, which owing to its meanders is at present of minor importance for navigation, could, in the author's view, be made into a navigable highway at little expense. The projected railway link with Transylvania via Buzău, Nehoiasi and Braşov will produce a more direct route than any existing to-day, and may serve to divert some of Transylvania's traffic via the Black Sea.

Both volumes, though breathing obvious patriotism, are refreshingly free from propaganda. M. R. S.

THE RE-BIRTH OF POLAND. By Dr. W. K. Korostowetz. *London: Geoffrey Bles* 1928. 9×6 *inches;* 317 *pages.* 10*s* 6*d*

It is not to be expected that a Russian official of the old régime can have much good to say about Poland; but this is so consistently scathing a denunciation that it is liable to defeat its own object, and the reader is inclined to suspect bias to be at work in every statement. And it is hardly for Russians to accuse Poles of the harsh treatment of national minorities. However, this is not the place to deal at length with a work that is mainly political and only becomes interesting when the writer breaks off from his tirade to describe some astonishing and "film-like" adventures of Russian refugees or to trace the relations of Danzig with England and Scotland from 1282 onwards. The last-named account represents a valuable piece of historical research among the archives of the Free City. J. H. R.

PERSIAN DAYS. By Copley Amory. *London: Methuen* 1928. 9×6 *inches;* xviii+230 *pages; illustrations and sketch-map.* 10*s* 6*d*

This book contains a somewhat full account of the well-known road from Tehran to Shiraz, with many references to the author's car "Nanette." As American *Chargé d'Affaires*, he possessed some slight knowledge of Persian customs but not apparently of the language, and he mainly repeats the stock "chestnuts" which appear in many other works.

The author expresses his appreciation of the cleanliness and comfort to be found at the various stations of the Indo-European Telegraph Department, and remarks of the company that "perhaps in no other instance has British enterprise and capacity contributed more to the benefit of Persia." No tribute could be better merited. At Shiraz he states that the Persian garden "is unlike a garden in America or England or France. It comes nearer to its Italian prototype." Surely Persian gardens were the prototypes of Italian pleasaunces! From Shiraz the author travelled eastwards past Lake Niriz to Saidabad and Kerman along a route that was much used by the British during the Great War. Indeed, it is entirely thanks to their engineers that "Nanette" was able to travel along it and up the very steep pass to the east of Niriz. At Kerman a good account is given of the carpets, while the opium question is discussed with distinct insight.

The book is pleasantly written, is well illustrated, and there is a map.

P. M. S.

BOTH SIDES OF THE JORDAN. By Norah Rowan-Hamilton. *London: Herbert Jenkins Ltd.* 1928. 9×6 *inches;* 320 *pages, and illustrations.* 12*s* 6*d*

This is described as "a woman's adventures in the Near East." The writer, who is more of a journalist than a student, had the good fortune, through becoming attached to an International Archæological Congress, which visited Syria and

Palestine in 1926, to visit Palmyra and Petra. This, too, at a time politically so unsettled that no isolated tourist could have ventured. The narrative begins in Jerusalem at the time of our Easter and ends there at the Eastern Easter. In the quest of adventures, a solitary journey from Haifa to Beirut, consequent upon neglect to obtain a *visa*, and a diversion from the Congress itinerary to visit Damascus—then in a particularly unhappy state—provide the best literary material. The author's descriptions are picturesque and full of imagination. Her book is a very human document full of conversations and personal reflections. Much light is thrown upon the state of political tension existing at that time between the Syrians and the French, and this is contrasted—quite justly—with the evident tranquillity of Palestine. Unfortunately there are many mistakes in names—probably from careless proof-reading—*e.g.* "one of the cities of the Decameron—Godava," Yafrefre (for Yafufi), Honis (for Homs), Zer'm (for Zerīn), Yabjha (for Yabigha). E. W. G. M.

SEAPORTS OF INDIA AND CEYLON. By ALLISTER MACMILLAN. *London: W. H. & L. Collingridge* 1928. 11×9 *inches; 498 pages; folding map and illustrations.* £4 4*s*

This beautifully produced volume will be of value to geographers principally because of its description of the leading ports of India and Ceylon—Calcutta, Bombay, Madras, Karachi, Rangoon and Colombo—and its profusion of photographic illustrations depicting all phases of Indian life. The descriptive matter occupies about 200 pages out of a total of 500; attractively and brightly written, it is generally accurate and enriched with local details which betoken the work of a careful and alert observer. The remainder of the book is occupied by what purports to be a commercial directory of the ports. Here the author hardly shows a due sense of proportion in his laudations of the various firms whose activities are described. One notices the absence of leading companies whose names are household words throughout the East, and one suspects that only subscribers are included in the directory, which is incomplete and therefore misleading to the uninformed. L. D. S.

HUI-HUI. By WILHELM FILCHNER. *Berlin-Schoeneberg: Peter J. Oestergaard Verlag* 1928. 8×5 *inches; 423 pages; illustrations and a map.*

After examination of the origins of Islam, tiresome to those to whom they are a commonplace, the author brings us to the spread of the religion into Eastern Turkestan, culminating in the régime of Yakub Beg in Kashgar (1861–1873).

Only in the five chapters which follow does the author hold our attention, and hold it closely; but our interest flags as soon as he draws deductions from this epoch and tells us how, with the downfall of Yakub at the hands of the Chinese, an inflammable mass of Moslem element fled, mainly far eastward, reinforcing existing Muhammadanism in that area. His contention is that Islam, bad enough in the West, becomes a mania in the hands of uncontrollable Mongols, and he reinforces his argument with figures and a rather impressive diagram of the numbers of Muhammadans in China. He seems to regard this as a growing peril, only to be met by action in common on the part of England, Russia, and China. He fails, however, to make us see that the misfortune is great enough to make bedfellows of three such divergent powers; nor does he take sufficient count of the fact that since the Angora abdication Islam is travelling in confused circles for want of a common leadership, and that the shed mantle is unlikely, for some time to come, to fall on anybody.

His patient and learned labour, not to mention his three close-printed pages of bibliography, leaves us in the end unconvinced; a great pity, since his clear,

curt, and vivid idiom is free from sophistry. The map is a model of how to confine cartography to the needs of the letterpress. He has been badly advised in his bizarre "new-art" binding, out of harmony as it is with the sincerity of the contents. An index is absent. L. A. B.

THE MONKS OF KÛBLÂI KHÂN. Translated from the Syriac by Sir F. A. WALLIS BUDGE. *London: Religious Tract Society* 1928. 9×6 *inches;* xvi+335 *pages; illustrations.* 12*s* 6*d*

The Syriac 'History of Mar Yahballaha III and Rabban Sawma,' one of the most valuable firsthand documents on the Mongols of Persia and the fortunes of the Nestorian Church in Asia, has hitherto failed to receive in this country the attention it deserves. Professor Montgomery's translation of the first part, published in New York in 1927, and covering only the travels of the two monks from China to Persia and Europe, rendered it the more desirable that a complete English version should be made, and the appearance of this edition is a welcome coincidence. Sir Wallis Budge has prefixed to his translation an erudite if rather discursive introduction on the Mongols and Nestorians, based on both Syriac and European sources. Maabar, however, is not Malabar, but Coromandel, and Professor Saeki is not always a reliable guide to the history of the early Muhammadans in China. The relative accuracy of the two translations must be left to Syriac scholars to decide; from the geographical point of view the only charge to be made against Sir Wallis Budge is that he has overlooked the studies of Professor Pelliot and others in the journal *T'oung Pao.* H. A. R. G.

BURIED TREASURES OF CHINESE TURKESTAN: an account of the activities and adventures of the Second and Third German Turfan Expeditions. By ALBERT VON LE COQ. Translated by ANNA BARWELL. *London: George Allen & Unwin Ltd.* 1928. 9×6 *inches;* 180 *pages, and illustrations.* 18*s*

The work of the German Turfan Expeditions, the complement of that done by Sir Aurel Stein and investigators of other nationalities, deserves the wider public which this book will ensure. The original German version, 'Auf Hellas Spuren in Ostturkistan,' has been reviewed in the *Journal* (November 1928, p. 474); the translation is literal, and at times rather stiff. All the previous illustrations are reproduced, but, unlike the German edition, it lacks even one page sketch-map.

ORANG UTAN: Bei den Urwaldmenschen Malayas und Sumatras. By PAUL SCHEBESTA. *Leipzig: F. A. Brockhaus* 1928. 9×6 *inches;* 268 *pages;* 125 *illustrations and two maps*

This work is supplementary to the same author's 'Bei den Urwaldzwergen von Malaya,' reviewed in the *Journal* of November 1927 (p. 491), and gives a further description of his anthropological work among the little-known forest tribes of the Malay Peninsula and Sumatra between January 1924 and September 1925. He first visited the Ple group in the mountainous region of Temengor in upper Perak, crossed into Kelantan and spent some time in the Nenggiri–Setong district among the Menri negritoes, penetrating into country previously unvisited by Europeans. Thence he proceeded up the Nenggiri river in rafts to the first Semai village, and descended the Kelantan river to Kota Bharu, whence he reached Penang by rail. His next journey was through the Batang Padang valley and into the hills of Pahang, and after a period among the Mantra and Serani of Malacca (who speak a mixture of Malay and archaic Portuguese), he journeyed to the Krau district (Pahang) and spent some weeks among the

Jakun (Jakudn in his spelling) villages on the Triang and Bera rivers. His expedition ended in Sumatra, and was there mainly confined to the neighbourhood of the Lalang river, Palembang, where he studied the primitive Kubu groups of Pajit, Kangdang and Ulu Bahal.

The author insists that the Semal, Sakai and Jakun tribes are three entirely different races, showing similarities with one another only where they have intermarried. His previous work having dealt with the Semang, he does not refer to them in detail here save to mention that they have no fixed place of abode but live as nomads, existing on what the forest provides. The Sakai, or Senoi—a small, golden-skinned, fine-looking tribe—live in communal huts and are agriculturists. They use a peculiar idiom in speaking which differs widely from that of the Jakun-Kubu, whose speech is an archaic form of the Malay tongue. The Jakun-Kubu appear larger in stature than the Sakai, due more to their heavier build than to actual height. Their features are not unlike those of the Malay, and they show more Mongolian traits than do the Sakai. They are also agriculturists, but live in one-family huts and seldom build villages, each family living alone in the middle of its plantations. Both tribes are superstitious, but the Sakai fear most the spirits of the dead: the Jakun, those of Nature.

All this, and much else besides, is described in a book that is full of detailed and carefully sifted information. But the author is something more than a trained observer, he is a courageous traveller, for he went through difficult forest country taking with him the barest necessaries of life and only two Malay followers, since a large retinue would have been fatal to his plans. There is also abundant evidence in his book that he has the rare faculty of winning the sympathy of the shy folk amongst whom he went: and it must be remembered that many of them had never seen a white man before. The plan he always followed in his wanderings was to remain for several days in the villages through which he passed, gradually winning the confidence and friendship of the inhabitants, studying their customs, religion, and mode of life, and taking the interesting photographs with which the book is plentifully illustrated. From each village he would obtain guides to lead him to the next.

The book is a valuable amplification of the works of Skeat, Blagden and Evans, to whom it is surprising that he does not refer. When reviewing his previous book we expressed a hope that it would be republished in English, and we are glad to notice that this has been done. The present volume deserves similar treatment. O. R.

UNFATHOMED JAPAN: A Travel Tale in the Highways and Byways of Japan and Formosa. By HAROLD and ALICE FOGHT. *London and New York: The Macmillan Company* 1928. 9×6 *inches;* xvii+438 *pages; maps and illustrations.* 21*s*

Mr. and Mrs. Foght went to Japan as the guests of the National Association for the Encouragement of Learning and of the *Kokumin Shimbun*, one of Japan's most important daily papers, Mr. Foght's primary object being to make a survey of Japanese education and to deliver a series of educational lectures throughout the prefectures. This book is the personal record of the authors' tour through Japan and Formosa. They went to a great many places and saw a great deal; and they appear to have been at some pains to leave nothing out of their narrative. Whether their title is justified is another matter. They learnt from Government officials that Mrs. Foght was the first Western woman to tread "certain remote paths and to see certain intimate sights:" but a European resident might have been constrained to tell them that the Japanese are such charming hosts that this edifying assurance is almost a formula. The chief drawback to the

officially conducted tour is that the traveller sees only what the conductor wishes him to see, and the present volume would have had more value had it been more constructively critical. O. R.

GREAT BRITAIN IN EGYPT. By Major Polson Newman. *London: Cassell & Co.* 1928. 9×6 *inches;* xvi+304 *pages; maps and illustrations.* 15*s*

Major Polson Newman's book seems to have started as a life of Arabi Pasha: it has ended as a survey of Egyptian history from Ismail to 1927. The work consequently lacks balance. The access to official documents mentioned in the preface doubtless refers to researches covering the early period, since it is more than doubtful whether the Foreign Office would have consented to a perusal of current or even recent correspondence: and his reference to such official assistance therefore needs some qualification if it is to avoid being misleading. The account which Major Newman gives of the history and causes which led up to the bombardment of Alexandria is admirable. His interpretation of the period immediately before 1882 is so plausible that, although favourable to Arabi, it does not offend verisimilitude like the accounts of Wilfred Blunt, and thus goes far to satisfy the reader that his version is good history. It is a pity in more than this connection only that the volume was not restricted to an examination of the Arabi period. In the expansion which the book suffered the Kitchener and Cromer régimes have been sacrificed to make room, apparently owing to its appeal to the public, for an account of the modern phase from 1914 to 1927. But the space left to deal with this part, though considerable, is either too great or too small to be quite fair to the protagonists. The author justifies, as we feel sure history will justify, Sir Reginald Wingate's policy in trying to persuade the Foreign Office to give Zaghlul a hearing in 1919. But the subject is too large and still too near for everything to be said here; and, let it be remembered, we have not yet heard Wingate himself. The last chapter on Lord Lloyd is history still in progress, and therefore the prerogative of journalists. An implied advocacy of Lord Lloyd's policy in a serious historical volume is premature. Until he has succeeded or failed in his Egyptian mission, praise or defence suggests that he requires one or other; this is either unfortunate or impertinent. F. R. R.

MANITOBA MILESTONES. By Margaret McWilliam. *London: J. M. Dent* 1928. 8×5 *inches;* xiii+249 *pages; illustrations and maps.* 7*s* 6*d*

In the opening chapters the writer attempts to sketch the travels of the early western explorers, such as Radisson and Groseilliers, Kelsey, Hearne and Vérendrye, with the growth of the fur trade under the Hudson Bay Company, and their later rivals the Scotch Canadians of the North-West Company (founded by amalgamation in 1784). These took command of the more southerly field of the Great Lakes after the conquest of Canada in 1763. From the end of the Revolution until almost the beginning of the nineteenth century their most formidable rivalry was not with Hudson's Bay but with the adjoining trading groups of the United States. The author thus assigns too much moral credit to Hudson Bay when she refers to their greater readiness to give up liquor as an article of sale in the fur trade. Two-thirds of the trade came from south of the international boundary-line, and in order to retain that commerce in an alien territory against American competition, rum was absolutely indispensable to the traders of the North-West Company. In 1791 even provincial licensing was abolished.

The tragic beginnings of Lord Selkirk's settlement are well described; but the author is more at home when she tells the story of the founding of Winnipeg and

the early village history of the West with its perennial misfortunes of plague, civil strife, and Indian rebellion. The final chapters are concerned with the coming of the railways, the vast European immigrations, the knotty problems of religion and compulsory education, and the testing effects of the Great War.

The book is a chronological survey. But it is perhaps unfortunate that the author did not entirely leave aside the broad fields of exploration and trade and confine herself at somewhat greater length to the fascinating story of Manitoba's development, with which she is more intimately associated. To discuss the early period in the romantic vein, as Mrs. McWilliams obviously intends, requires a command of every aspect of the huge subject, which even then only a Parkman may succeed in accomplishing well.

The book is well illustrated, and contains at the end a useful summary of events along with a rather too select bibliography and a rather too curtailed index. G. S. G.

LABRADOR LOOKS AT THE ORIENT: notes on travel in the Near and Far East. By Sir WILFRED GRENFELL. *London: Jarrolds Ltd.* 1928. 9×6 *inches;* 288 *pages and illustrations.* 15*s*

In 286 short pages Dr. Grenfell describes a journey begun in 1924, to Egypt, Palestine, 'Iraq, India, Malaya, China and Japan. The account has inevitably an air of superficiality: nevertheless a truly liberal spirit, such as might be expected from one who has practised what he preaches, illumines the writer's relations with the various peoples he meets, and for that reason the book may be read with some profit.

It is unfortunate that popular fallacies about Muhammadan divorce law, the opium traffic, the political conditions in India, and so forth, have been too uncritically accepted. And why is Japan, with her 77 millions of inhabitants, still spoken of as "this little nation"? The spelling of place and other names is occasionally startling, and apparently not always due to careless proof-reading, or misprint; for example, Kabela (for Kerbela or Karbala), Khardemain (Kadhimain), Bazra and Bazrah (Basra), Suttej (Sutlej), Sumites (Sunnites).
A. S. E.-S.

THE MAGIC LAND OF THE MAYA. W. LAVALLIN PUXLEY. *London: George Allen & Unwin, Ltd.* 1928. 244 *pages; illustrations.* 12*s* 6*d*

Mr. Puxley is a sympathetic observer of nature, and in consequence the notes of his wanderings possess a certain charm; and he spares us economic facts and figures when dealing with Latin America. But readers who look for light upon Maya regions may be disappointed, since apparently the author spent his time first in Tampico and its neighbourhood (calling it "Central America" for some reason unknown to geographers), and later in and about Mexico City. The photographs used for illustrations are chiefly views very well known; one seldom knows just what place is being described. There is neither map nor index; and Mr. Puxley should restrain his fondness for quotations of verse. But when these objections to book-making have been registered, one must give the author credit for an agreeable, leisurely style and a true appreciation of the kindly folk of the wayside. There are a few notes on birds, fishes, and plants, and fragments of history, slightly treated. L. E. J.

THE CHINESE REVOLUTION, 1926–27. By H. OWEN CHAPMAN. *London: Constable & Co. Ltd.* 1928. 9×6 *inches;* xviii+310 *pages, and map.* 12*s*

A comprehensive and useful survey of a pregnant period, valuable for students of Chinese affairs, and emphasizing the importance for the understanding of

them of a geographical knowledge of the country. The author, who was closely in touch with events, keeps himself in the background, but his judgments are valuable. He shows some real appreciation of the mind of Modern China, and can give gentle though none the less effective rebukes to the "old China birds" who think "they know their China." He deprecates generalizations, such as those commonly made about the "Asiatic." Asia is, after all, "a geographical expression."

There is some criticism of the part played by Japan, but in justice it should now be pointed out that her action in 1928, *after Communism had been defeated*, though similar to that of 1927, did not save Peking for the Northerners. The principle of the subordination of the military to the civil power is not a new but a very old one in Chinese political theory, and was pretty strictly upheld till 1912. "Pekin" is spelt throughout thus, though Nanking is correctly rendered. On p. 194 the second paragraph should read, "the branch line *south*"—not "*north* of the river. . . ." A. S. E.-S.

CHINESE REALITIES. By JOHN FOSTER. *London: Edinburgh House Press* 1928. 7×5 *inches; 240 pages, and sketch-map. 2s 6d*

An interpretation of the mind of "Young China" from the point of view of a Christian Missionary. The present-day religious aspect is treated with sincerity and carries conviction, but the author's general judgments must be received with caution. They are based on an inadequate grasp of the old Chinese civilization and history. It is misleading to speak of Confucianism as a "religion," and the mystical influences of both Taoism and Buddhism are not properly appreciated. The popular fallacy that Chinese civilization was static is repeated. It is most misleading to suggest that the Chinese literary language stands to the colloquial in the same relationship as Latin does to the Western European languages.

Recent events indicate that "Young China" is not going to have matters all its own way in the reconstruction of the country, and on the whole well-wishers will be glad of this.

The date "1913" on p. 64 is a misprint for "1912." A. S. E.-S.

A TOUR IN AUSTRALIA AND NEW ZEALAND: Grassland and other Studies. By Professor R. G. STAPLEDON. *Oxford University Press (Humphrey Milford)* 1928. 9×6 *inches;* xv+128 *pages, and illustrations. 7s 6d*

The tour upon which this book is based has given birth to something much more than a record of travel: the written account constitutes in reality a practical scientific work upon grasses and grass lands, their establishment in remote and widely differing regions, the ills they are subject to, and the methods by which they can be restored and invigorated. An acknowledged expert has here given rein to his enthusiasm for science, and travel has thus become but a means to an end.

Professor Stapledon's main pre-occupation is the outstanding importance of grass lands to the British Empire and especially to Australia and New Zealand. Hitherto purely empirical methods have been in the main followed in treating these grass lands, but it becomes abundantly clear from this work that science and organization are needed to stay wholesale impoverishment on the one hand, and to get the most out of productive pastures on the other. Only the merest fringe of this vast subject has as yet been attacked.

In the course of this reasoned work there is necessarily much technical detail that falls exclusively within the province of the specialized botanist and plant-breeder, but there is also a wealth of shrewd observations on everyday pastoral

problems which will be of value to the farmer and the administrator as well as to the agricultural college expert. The final chapter, in which a scheme for herbage seed production for Empire needs is outlined, is the logical outcome of the previous chapters, at the same time breaking extensive fresh ground and giving rise to serious thought; while to the ordinary layman the early chapter, dealing with farming and other features in the "new" countries, will appear peculiarly informative. E. W. S.

PIONEERING IN POVERTY BAY, N.Z. By PHILIP T. KENWAY. *London: John Murray* 1928. 7×5 *inches;* xii+246 *pages; illustrations.* 7*s* 6*d*

This is a charming little book, alive with the author's personality and full of local colour. Mr. Kenway must indeed be regarded as a fortunate man, not so much because of his material success, of which he says little, though it appears to have been considerable, as because of his whole-hearted capacity to enjoy pioneering life (unrelieved at first by the amenities of civilization which he contrived later to introduce), his ardent love of nature which he found leisure to observe in her unspoiled fastnesses, and his keen interest in the human beings whose lot was cast with his.

Any one who knows by intimate early associations the country and the life described by Mr. Kenway, will realize how vivid and full-bodied is the account given here in an easy prose style, reinforced by snatches of racy verse and a number of apt photographic illustrations; and how well the office clerk from the Old Country adapted himself to a totally new environment where resourcefulness, never-failing good humour, and an abundance of vitality are the prime essentials. A pleasing feature is the manner in which the pioneer never loses touch with the gentler things of life—with the love of flowers, of good reading, of music and of simple pastimes—and never fails to remain superior to everyday mischances and the caprices of drifting station-hands. It is perhaps not too high praise to say that we have here a picture of the British Empire-building spirit at work at its best. E. W. S.

HANDBOOK TO TASMANIA. By various authors. *Australian Association for the Advancement of Science, Hobart* 1927. 8×5 *inches;* 135 *pages; illustrations and map.* 3*s*

This handbook, by various experts, describes the island of Tasmania under the several section headings familiar to those who follow the discussions of Associations for the Advancement of Science. A special feature of the book is the space given to matters bearing on the economic life of the island—to agriculture, forestry, manufactures and hydro-electric development, the material given under these heads being rounded off with a general economic sketch.

From this book one gets a clear, if somewhat depressing, picture of the present position of Tasmanian industries and of the outlook for their future. Tasmania is relatively poor in natural resources. Much of the land is almost useless for agriculture or indeed for the pastoral industry, even in the less mountainous and less storm-swept central and eastern districts. The mineral wealth is limited, in the present state of mining technique. Much of the original forest has been recklessly destroyed, and reforestation has as yet received small attention. The economic competition of the other States of the Commonwealth, in short, appears to be too strong in almost every direction for the smallest and weakest of the partners, which has been steadily losing population to the mainland.

Some constructive proposals are made by the authors, but they do not seem capable of carrying the island far on the way to prosperity; but it is at least a

useful achievement on their part to have given a dispassionate scientific account of the natural endowment. E. W. S.

AU NORD DU GROENLAND. By LAUGE KOCH. Préface du Comndt. J. B. CHARCOT. *Paris: Pierre Roger* 1928. 10×6 *inches;* viii+291 *pages; illustrations and maps.*

This is a translation of the original Danish account of Dr. Lauge Koch's expedition to the north coast of Greenland in 1921–22. An account of it was given in the *Journal* for July 1924. Its importance was considerable, for although much of the route had been traversed by Peary, Dr. Koch's surveys were in more detail and linked up the Danish work in the west, in the area of Denmark's colonial administration, with the Danish surveys in the east which were made by Mylius Erichsen in the "Danmark" expedition of 1906–08 and Einar Mikkelsen in 1910. This completion of the Danish survey of Greenland was the main object of the expedition which was organized to mark the bicentenary of Hans Egede's landing in Greenland. From his base in Upernivik Dr. Koch left for the north early in January 1921 and travelled by the coast-ice to Fort Conger in Grant Land. From there he continued with three Eskimo round the north of Greenland into Independence fjord. The most striking discovery was the re-establishment of Peary Channel. Peary had supposed that this channel separated Peary Land from Greenland. Erichsen had proved that there was no such sea channel, but Dr. Koch discovered a deep valley not over 500 feet in altitude lying approximately in the position of the channel. The long lakes which it contains add to the illusion of an arm of the sea. The return journey was made over the ice-sheet to Kane basin and then mainly by the coast to Upernivik. In addition to his surveys Dr. Koch did much useful work in geology. In spite of the monotony of such a journey Dr. Koch has written an attractive narrative which holds the reader's attention He had many anxious days in want of game, for he and his companions lived off the country, but he makes light of these and other difficulties. The volume is well illustrated by over a hundred photographs and contains two large maps, one of the north of Greenland and the other of the whole of Greenland. The lack of an index or a detailed table of contents makes reference to any particular part of the journey a matter of difficulty. Dr. J. B. Charcot writes a prefatory note. R. N. R. B.

DIE KOLUMBUS-ORIGINALE. (Eine paläographische Studie.) By FRITZ STREICHER. *Munich:* 1928. 10×7 *inches;* 54 *pages; facsimiles*

The question whether Columbus was a man of learning or something of an ignoramus will probably never be answered to the complete satisfaction of every one, but is one to the discussion of which Herr Streicher makes an extremely interesting contribution in this exhaustive monograph. He rejects the view, held by Cesare de Lollis and others, that the handwriting of the Admiral may be classified as being of two kinds, the "*a*-type" and its "variants." Adopting as the basis of his investigation the signature of Columbus and the phrases with which his signature is accompanied, he accepts as genuine all the three forms, "El Almirante," "Xpo FERENS" and "xpo ferens." He argues that from these materials it is possible to discover a number of marked peculiarities of writing, which he enumerates (pp. 216–217) and which supply the necessary clues by which the genuine may be distinguished from the spurious. The idea that the appearance of a small cross in the upper margin of a letter indicates Columbian authorship is, he declares, fallacious; it was a general practice in that age to place such a cross in the centre of the upper margin.

Herr Streicher holds that only documents of the *a*-type may be regarded as in the handwriting of Columbus, and accordingly he rejects a number of supposed examples of that handwriting. Among those so rejected are the interesting scheme for the organization of Española, drawn up in 1493; the memorial on the needs of the island, dating from either 1495–6 or 1501; the letter to Ferdinand and Isabella on the navigation of the Indies of 1502; and the important letter to Diego Columbus, dated 29 December 1504, although in the last case the signature is in the writing of Columbus. Of the notes, Herr Streicher rejects all those on Aeneas Sylvius and Plutarch and many of those on Marco Polo. He discusses at some length the question of the authenticity of the sketch-map of Española, which he regards as being a genuine specimen. He admits that the "g" in Tortuga and still more the "e" in "monte" and in "espanola" are quite unlike the *a*-type, as are the letters *a*, *c*, *e*, *g*, *h*, *r*, and *s*, in the writing on the back of the sketch-map. But he contends that many of the essential peculiarities of the handwriting of Columbus do appear and that the very variations themselves may be paralleled in the next earliest specimen of his writing in 1498. To Herr Streicher's argument it might obviously be objected that a forger would almost certainly have reproduced obvious peculiarities, and that it is in the less obvious that the test of the genuineness should more properly be sought.

No one not possessed of a very exhaustive knowledge of the Spanish cursive handwriting of the period is in a position to determine how far the supposed "characteristic features" are characteristic in fact. Some at least of those enumerated by Herr Streicher seem to appear in documents which were certainly not written by Columbus, for example, the *e* and the *f*. It would, perhaps, be unsafe to draw any very serious conclusions from the evidence of handwriting: it is too notorious that handwriting experts are constantly at variance in the law courts. But Herr Streicher has at any rate written a valuable essay, and a tribute must be paid to the thoroughness with which he has treated the question, to the lucidity of his argument, and to the excellence of the facsimiles with which the paper is illustrated. C. J.

ECONOMIC GEOGRAPHY WITH SPECIAL REFERENCE TO THE BRITISH EMPIRE. By D. E. WILLINGTON. *London: The Gregg Publishing Co. Ltd.* [1927]. 9×6 *inches;* viii+325 *pages, and* 40 *diagrams.* 7*s* 6*d*

The author states in his preface that this book is primarily intended for use by candidates for such professional examinations as those conducted by the Institute of Bankers, but that it should be useful also to teachers and senior students in secondary schools. The first fifty pages are occupied by an account of the geographical factors influencing commerce and the chief commodities of commerce, the whole of the remainder by a systematic account of the British Empire, country by country. The information is, with some exceptions, up to date and accurate, though some of the author's interpretations seem hurried or superficial. Thus it is a little doubtful whether the ports of the British Isles can be classified into three groups (*a*) London and Southampton; (*b*) Ports which are outlets for coalfields; and (*c*) Dublin and Belfast. Some of the catalogues of facts are reminiscent of the old type of text-book which one might hope to be dead, and are, at the same time, incomplete. Thus on pp. 121–2 fourteen regular routes between British ports and the Continent are listed, but one notices the inclusion of Queenborough–Flushing and the omission of Gravesend–Rotterdam, the Cherbourg and St. Malo routes, and the Bergen routes. Porthcurno, the cable station, is of course not in Ireland, but in Cornwall. L. D. S.

THE SHADOW OF THE WORLD'S FUTURE: or the Earth's population possibilities and the consequences of the present rate of increase of the Earth's inhabitants. By Sir GEORGE HANDLEY KNIBBS. *London: Ernest Benn* 1928. 9×6 *inches;* 132 *pages.* 10*s* 6*d*

The present world population is approaching 2000 millions. The present rate of increase means that a number roughly equal to the population of Great Britain is being added to the world's total every two years. So large a figure gives pause to think, and Sir George Knibbs urges that therefore "the population-question is of the first order of importance for every person who has any interest in his country's future or in his children and children's children"; it is a question of vital moment to future social well being and world peace. For during the course of the present century the problem of the relationship between population capacity and food capacity must assume menacing proportions for the world at large. It is a problem in which world economic organization will play a major part, for which the world, however, is unprepared and for which no automatic or rapid adjustment is in sight. In other words, it is a problem that must be actively faced by all thinking men and that immediately.

In the first few chapters the author reviews the present distribution of the world's population and of animal, vegetable and mineral resources. This is followed by a critical examination of the possibilities of future extension. The whole argument is supported by illuminating, not deadening, statistics for the accuracy of which the author's name is sufficient guarantee. Chapters vi and vii deal with the increase of population, the several estimates of world-capacity, and the conditions by which they are affected. From this a natural sequence leads the author to apply his facts to some of the outstanding problems of the world to-day. These are of infinite variety, economic, social and political; some are national, others international, and others again concern all humanity. But of these the book must be left to speak for itself.

Suffice it to say that it is a sketch which all thinking men, others besides geographers, will do well to read and ponder seriously. Though other economists may take a more optimistic view based on a decrease in the rate of population-growth in the future and on an increase of food-production through probable, but not certain, scientific discoveries, the outlook of the author is broad and thoughtful, the treatment appeals by its restraint and obvious sincerity, the book is packed with valuable material. The publishers too are to be congratulated on the clear type and tasteful format, but the price is high. C. C. C.

THE EARTH AND ITS HISTORY: A text-book of Geology. By J. H. BRADLEY. *Boston and London: Ginn & Co.* 1928. 8½×6 *inches;* viii+414 *pages;* 257 *figs.* 12*s* 6*d*

Elementary text-books of geology are so numerous that one has a right to expect in a new one either a novel point of view or a novel method of treatment or the incorporation of some of the latest results of research. The present volume, though well printed and well illustrated and published at a very reasonable price, can scarcely be said to satisfy these expectations. According to the author's preface, the volume is an attempt to write a book expressly for the short course, "for the general student who desires to be intelligent about the earth." The opening sentence is typical of a certain looseness of thought and expression found throughout which makes it impossible to regard the text-book as accurate or reliable, even for the purpose for which it is written. "Geology is usually defined as the science that treats of the Earth and its inhabitants" is the opening sentence referred to: is this a "usual definition" of geology? Is not the bald statement too indefinite even to be true? More serious

examples may be selected at random, for few pages are without them. Extrusive igneous rocks "usually cool so rapidly that individual minerals have no time to form" (p. 34); "the pockets of the wind, like those of a small boy, are filled with a variety of things" (p. 47); "certain microscopic blue-green algae from Minnesota are the only direct evidence of living creatures in the Archeozoic rocks" (p. 322); "petroleum is always found in association with marine sedimentary rocks" (p. 390); "black shales are thought to be the parent of all commercial deposits of petroleum" (p. 390); "most of the valuable iron deposits of the world are of sedimentary origin" (p. 392). On the other hand sins of omission include the absence of any reference to such modern important developments of geological science as the theory of continental drift, the original structure of the Earth's crust and climatic cycles. Actual errors are by no means absent; amongst these may be included the retention of the Lyellian percentages of extinct mollusc as defining the epochs of Tertiary time (pp. 270–2).

L. D. S.

TRAVEL DIARIES OF WILLIAM BECKFORD OF FONTHILL. Edited by GUY CHAPMAN. Two volumes. *London: Constable* 1928. 9×6 *inches;* lxii +348, xviii+374 *pages; illustrations.* 42*s*

This fine edition should do much to remind us what an entertaining traveller Beckford was. We are apt to think of him as a spoilt and self-indulgent man, whose wealth and sheltered life kept him aloof from such common things as humour and good company. He never perhaps quite recovered from his youthful coddling, and he was always a little oppressed by the sense of his own importance, which was unfortunate, for these travel diaries show what an excellent fellow he could be—shrewd, observant, kindly and full of humour. In 1787 he visited Portugal, where his friendship with a nobleman enabled him to acquaint himself with the affairs of the court and kingdom. He extended his tour to Spain, and returning by way of Paris witnessed the destruction of the Bastille. He was abroad again in 1791 and 1792. He visited Lausanne, where he purchased Gibbon's library, and in 1794 he went once more to Portugal, visiting Cintra, and writing one of the best descriptions of Alcobaça and Batalha which we are ever likely to have. These travels have to some extent become famous, but Beckford has much of interest to tell us also about Holland, Flanders, the Rhine, Munich, and Tirol. His sense of humour never leaves him. At Ems he encountered a gentleman who thought he had found a place which embraced every worldly pleasure, and when Beckford announced his intention of proceeding his companion was afflicted with melancholy. "Sir," said he, "your route is to be sure very perilous: on the left you have a chasm down which, should your horses take the smallest alarm, you are infallibly precipitated; to the right hangs an impervious wood, and there, sir, I can assure you are wolves enough to devour a regiment. . . . Should you venture through this hazardous district tomorrow you will, in all probability, meet a company of people who have just left the town to search for the mangled bodies of their relations; but, for Heaven's sake, sir, if you value your life, do not suffer an idle curiosity to lead you over such dangerous regions, however picturesque their appearance." Nevertheless, on the next night Beckford was able to sleep in peace and tranquillity at Wiesbaden.

There is much else which is interesting and amusing in these delightful volumes, which reflect the spirit of leisured travel in a way which it is difficult to describe. They are well edited, but the absence of an index is a grave defect.

M. L.

DEEP-SEA BUBBLES; or The Cruise of the *Anna Lombard*. By H. H. Bootes. *London: Ernest Benn* 1928. 9×5 *inches;* 264 *pages.* 10*s* 6*d*

On the jacket the publishers state that they "do not know whether to call this extraordinary book fiction or autobiography," but we gather that the author means it to be taken as a true account of a most unusual voyage. The ship, which is disguised under the name of *Anna Lombard*, was a French ship built for the Chinese trade and subsequently used to carry convicts to New Caledonia. It was chartered in the eighties of last century by a syndicate of "German and English medical men" for the cruise which the third mate describes in this book. The charterers are said to have discovered the elixir of life in pure spermaceti and to have undertaken the cruise in order to collect this substance on the Pacific whaling grounds. Various incidents of wonderful cures effected with this oil are related. The voyage was via the Straits of Magellan and Chilean ports to the tropical regions of the Pacific, with calls at Easter Island and the Marquesas. The usual incidents of such a cruise are recorded as well as encounters with a giant octopus and a huge deep-sea conger. The personnel of the ship's company was extraordinary and strangely unlike the customary whaling crew. It included an exiled Chinese prince who sailed as steward, and the morganatic son of a German prince who previous to serving as mate of this ship had been a general in the Chilean army. This is quite possible and at any rate makes entertaining reading. The expedition terminated abruptly with quarrels among the staff, and the subsequent death of the captain brought the voyage to an end at San Francisco. R. N. R. B.

LA FORCE MOTRICE ANIMALE À TRAVERS LES AGES. By Commandant Lefebvre des Noëttes. Second edition. *Paris: Berger-Levrault* 1924. viii+132 *pages;* 217 *illustrations. Fr.*20

This is a concise study of the developments of harness as the means of applying the strength of horses and oxen to drawing loads—using the word "harness" in a wide sense to include all that connects the horse with the load. The illustrations are drawn from lands as far apart as Japan and England, and range in time from Chaldea to to-day. Several of the illustrations are of geographical interest; but the book as a whole is a study in social and economic history dealing with the development of one factor—the utilization of animal tractive power—which so far as the reviewer knows has not previously been the subject of any comparable monograph. C. B. F.

POPULAR MAP READING. By E. D. Laborde. *Cambridge: University Press* 1928. 7×5 *inches;* xii+118 *pages; diagrams and a map.* 6*s; also School edition* 4*s.* 6*d*

This is a text-book which the non-specialist can appreciate, written in a simple manner, and not too unpleasant to read. The effort to achieve simplicity however has led to one or two inconsistencies: terms such as "hill," "mountain," "one-inch scale" are defined, while the terms "horst" and "1/M map" are used without explanation. Omissions in the diagrams are apt to cause confusion, such as the leaving out of Points P, A, and C in figure 3, and the failure to number the contours in figure 17. In the latter diagram, (c) which is named a convex slope portrays both a convex and a concave slope whichever way the contours may be numbered. No definition of "Grid bearing" is given, although the use of the map grid for measuring bearings is mentioned in chapter one. The book is freely and well illustrated, and the exercises on each chapter enhance its value. The section on the "Interpretation of the Map" should do much to arouse enthusiasm for the subject, and can be read with interest not only by the map reader but also by the map maker. D. R. C.

THE MONTHLY RECORD

THE NORTHERN NEW HEBRIDES

The following note on the geology of the summit of Mount Tabwemasana Tauku was omitted from the end of Mr. Baker's paper on the Northern New Hebrides printed in this number (p. 325).

Mr. C. J. Bayzand has kindly examined the specimens of rock which we took from the summit of Mount Tabwemasana Tauku. He finds that the rock is Augite-Andesite. On microscopical examination of sections of the rock, the ground-mass is seen to be fine grained, with lath-shaped crystals of colourless plagioclase and fairly abundant magnetite. There are large well-defined phenocrysts of Augite, yellowish to light green in colour.

TRAFFIC ON THE RHINE

In the *Annales de Géographie* for November 1928 there are given some interesting figures relating to the traffic of the Rhine ports, drawn largely from recent issues of *La Navigation du Rhin*. The traffic of the port of Basel reached in 1927 the maximum recorded, proving that the various obstacles to the navigation of the upper Rhine are being overcome. Of the total handled, 739,840 tons, approximately seven-eighths came up the river; cereals and coal represented more than two-thirds of this traffic. The materials sent down-stream were chiefly iron ore, asphalt, and chemicals. The average burden of the barges was 950 tons. In contrast to these figures are those for the German Rhine ports, which totalled in 1927 about 66 million tons. The three divisions, upper, middle and lower Rhine, increase in importance in this order. The upper section is dominated by Mannheim, formerly the limit of navigation, with 7 million tons, followed by the industrial centre of Ludwigshavn with 4 million tons. On the middle Rhine, Cologne, the limit of marine traffic, had 2·4 million tons, and Mainz, which has suffered from railway competition, 1·6 million tons. The industrial areas of the Ruhr find an important outlet on the lower Rhine, the traffic figures for Duisburg–Ruhrort exceeding 24 million, and Schwelgern–Alsum 6 million tons, the former shipping coal in return for iron ore, wheat, timber, and petroleum.

Through the Dutch waterways, Antwerp shares in the Rhine traffic. Her total trade with Germany over inland waterways exceeded 4 million tons. The remittance of certain dues has also encouraged traffic with Alsace. In 1927, Antwerp despatched to Strasbourg over 700,000 tons of cereals, including wheat, maize, and rice from Saigon. In return, about 450,000 tons of potash, soda, etc., were shipped from Strasbourg to Antwerp. It is the value of this traffic that has directed Belgian attention towards the need for improving the canal communications, particularly the Hansweert–Wemeldingen waterway.

DR. TRINKLER'S JOURNEY IN CENTRAL ASIA

Dr. Emil Trinkler, favourably known for his previous travels in Afghanistan, organized in 1927 an expedition for research in Western Tibet and Chinese Turkestan. He was accompanied by a geologist, Dr. de Terra, and a botanist, Herr W. Bosshard. Accounts of the progress have appeared in the press from time to time, but the first account of the scientific work in earlier stages was published in *Petermanns Mitteilungen*, 9/10, 1928. The portion there described lay between Leh and Suget Karaul, a Chinese frontier post on the Karakash Daria. Setting out on July 12 from Leh, Suget Karol was not reached until 7 October 1927. The intention was to visit the Lighten lake and enter Chinese Turkestan by Polu, but the loss of many yaks during the crossing of the Aksai chin range forced the party to make as rapidly as possible for the nearest

Khirghiz settlements in the upper Karakash valley. On the journey the Sirigh Jilganing Kul lake, not previously visited by Europeans, was examined. On this first portion of the route from Leh nineteen determinations for position were made, and a topographical survey on the scale 1/100,000 executed, affording the means of correcting existing maps. Dr. de Terra also made a geological route survey. At the beginning of the journey rain and snowstorms were experienced, but on the plateau clear autumn weather conditions prevailed. During August night temperatures of −18° C. were recorded. This north-west portion of Tibet exhibits all the characteristics of a high plateau with interior drainage. What rainfall there is finds its way to the numerous small brackish or salt lakes. The great extremes of temperature have broken up the rock surfaces, and fretted the pinnacles of harder rocks into strange forms. The results of deflation are also evident: against the foot of the mountainous sides of the Karakash valley, sand-dunes up to 100 metres high were seen. The mountain profiles are in general smooth and shelving: the river valleys broad, with stream-beds cut in abrasive deposits. Evidence of two previous lake-levels was collected: these lie at approximately 5 and 15 metres above the present level. It is shown that the lower was previous to the last glaciation. The lake Sirigh Jilganing Kul was then three or four times its present area, and its banks, now desert, were thickly vegetated. Everywhere the signs of former extensive glaciation, in the form of great moraines, and glacial valleys high above present levels, are to be seen. The level of the last great glaciation was between 4200 and 4400 metres, and an earlier level was at 5000 metres, representing a temporary retreat. Dr. Trinkler asserts that these levels are traceable from the upper Indus valley to the Tarim basin, and prove the former existence of a great "inland ice" cap, the melting waters of which produced the features already described.

After leaving Suget Karol, Dr. Trinkler spent five months investigating the geological history of the western and south-western Takla Makan desert, while Dr. de Terra studied the geology of the Kuen Lun mountains south of Yarkand. The expedition finally left Yarkand in July last year, travelling through the Karakoram, and reaching Leh in August. These studies in the Takla Makan confirmed Dr. Trinkler in his belief in the existence, after the Ice Age, of a very extensive lake in the basin of Chinese Turkestan. By correlating archaeological and geological evidence, he concludes that portions of this great lake existed as late as the fourth or fifth centuries A.D., and this flooding had probably occurred on previous occasions. If Dr. Trinkler's theory can be maintained, it should help to solve the much-debated question of climatic pulsations in Central Asia.

THE KRUGER NATIONAL PARK, TRANSVAAL

The illustrated report by the Warden of this fine South African game sanctuary, Col. J. Stevenson-Hamilton, lately issued at Pretoria, brings out clearly the excellent work achieved within the past few years towards the preservation for posterity of the varied fauna of South Africa, the larger forms of which were otherwise threatened with early extinction. It is not perhaps generally known that the reserve dates back to the days of Transvaal independence, an area of Government land near the borders of Portuguese East Africa having been set apart by a proclamation dated 26 March 1898. By subsequent additions a tract of thinly-peopled country of about 200 by 60 miles, stretching along the whole eastern border of the Transvaal, was set apart for the purpose, the private ownership of certain lands within the reserve being the main obstacle to permanent security. The war, which depleted the staff of custodians, put matters back seriously, and the following increased demand for

land necessitated the excision of the whole western section. In 1926, however, the remainder was secured as a game sanctuary for all time by the passing of a law creating the Kruger National Park, measuring some 220 miles from north to south, with an average breadth of about 40 miles. It is described as a romantic land of forest and kopje, of reed-fringed rivers and wild boulder-trimmed gorges, and being easily accessible by rail, may in time become a popular holiday resort. Col. Stevenson-Hamilton has much to say on the conditions of life of the wild fauna, which, with the resumption of systematic administration in the past ten years, shows satisfactory signs of increase, and is in excellent condition generally. He insists throughout on the admirable balance between classes and species of animals maintained by nature when free, as it is here, from undue interference by man. Another matter discussed is the evidence, of which there are said to be clear traces, of progressive desiccation, but this is far less to be feared in a tract given over to natural conditions, than in a settled country. The game animals are held to do much good by forming small catchments (through their stamping and rolling) which check the off-flow of water. Discussing the natural relations between the carnivora and herbivora, the writer points out the importance of the former in keeping the latter healthy and active by destroying the unfit, and deprecates their complete extermination. In view of the random statements current as to the number of lions in the reserve, he carefully reviews the evidence and thinks that the total is probably less than 600. The reserve is a natural reservoir for all bird life, the usefulness of which in keeping down vermin is insisted on.

HUDSON BAY RAILWAY

The report for 1927–28 of the Canadian Deputy Minister of Railways states that considerable progress has been made with the Hudson Bay Railway since the decision to resume work upon it was made in 1926. At that time 214 miles of track were being used, though a further 118 miles had been laid, but all required reconditioning. The intention had been to make Nelson the terminal port, but a committee of the Senate recommended a fresh examination of the claims of Churchill and Nelson. After receiving the report of an English harbour engineer it was decided to make Churchill the terminus. It offers a harbour in which shipping facilities can be provided in calm water, protected from all storms by the surrounding cliffs. The cost of construction should be less than one-third of that at Nelson, and the time required one-half—that is, three years. The harbour at Churchill with little preparation can be made to admit vessels of 28 feet draught at any time, whereas at Nelson, without heavy expenditure for dredging, their entrance would be limited to short periods around high water at neap tides. The railway mileage from the junction with the Canadian National Railway in Saskatchewan to Churchill is 510, as compared with 422 to Nelson. About 462 miles have now been constructed. Work has already begun on the harbour, despite the handicap that communication is at present by sea. The total expenditure on the railway to date is 24 million dollars, with an additional 3·5 million dollars on the harbour.

RUSSIAN COLONY IN LOWER CALIFORNIA

An interesting example of the effects of a new environment upon a group of emigrants is described by Oscar Schmieder in 'The Russian Colony of Guadalupe Valley' (Univ. of California Publications in Geography, 2, No. 14, 1928). This settlement consisted originally of 100 families of Great Russians, who had been established by the Russian Government near Kars before going to America. At the beginning of this century, after some time spent in the United States, they purchased an ex-Mission ranch of about 13,000 acres, of which

6000 are arable, from the Mexican Government. To a considerable degree their traditional methods of land holding and cultivation have been preserved. The land belongs to the group, is divided into small fields allotted irregularly to the families, and after the harvest becomes common pasture. Despite the long distances to outlying fields, the colonists live in one large village; this necessitates the men camping on their fields sometimes for weeks. Though employing modern agricultural machinery (with horses in place of the customary oxen), they maintain their system of extensive agriculture, ploughing and working the land until it is worthless, and then bringing more under the plough. This would be impossible but for the fact that the neighbouring Mexicans are pastoralists, and are willing, in return for one-fifth of the produce, to rent the Russians as much land as they require. Naturally the yield is decreasing rapidly. But for the attraction of the United States, the settlement would have increased enormously in numbers, as families are large. All the younger people however move, temporarily at least, across the border, since restrictions upon immigrants do not apply to them. As the Mexican Government is striving to assimilate the settlement, and the older people are conservatively Russian, a strange contest between three cultures is in progress.

DISTRIBUTION OF RAINFALL IN CUBA

On the basis of data afforded by a memoir by Dr. O. L. Fassig, Mr. E. J. Foscue has published in the *Monthly Weather Review* (vol. 56, No. 5, 1928) a series of maps showing the monthly and annual distribution of rainfall over the island. Observations for varying series of years are available for nineteen stations, and they have been brought into uniformity by adjustment to a maximum length of twenty-five years. The map of annual rainfall shows the concentration of rain on the south side of the western part of the island, and the relatively light fall on the whole eastern half, though the comparison is somewhat marred by the absence of stations in the mountains behind Santiago near the eastern end. The variety of types within the island is shown by the fact that while Havana has the lowest record for any station (43 inches yearly), Union de Reyes, at no great distance in the interior to the south-east, has the highest (over 72 inches). Preston in the east has a pronounced winter maximum, while Santa Barbara in the Isle of Pines has a double summer maximum. Generally the first four months and the last two have the lightest rainfall, while two pronounced maxima occur over most of the island in June and September with a slight falling off in July and August, the June maximum being due to the vertical position of the sun and that of September to the prevalence then of tropical hurricanes. The areal distribution at different times is seen to be mainly due to the prevailing winds. During the winter the north-east trades bring rain to the exposed north coast, while in May the turn of the wind through east to south-east gives the heaviest summer rain to the south and south-west. The embayed form of the coast has also some influence.

A SPANISH ACCOUNT OF DRAKE'S VOYAGE

We have received from the Instituto de S. Juan, Madrid, through the courtesy of the British Embassy and Mr. F. D. Harford, a contemporary Spanish account of Drake's voyage round the world, and, in greater detail, of the taking of Santo Domingo and Cartagena in 1586, as first printed in 1921. The 'Discurso de el Capitan Francisco Draque' is a portion of a poetical composition by Juan de Castellanos, called the "Elegias de Varones Illustres de India." The verses dealing with Drake incurred the displeasure of the censor, so that they were not printed with the first part of the "Elegias": indeed it is only quite recently that this portion of the manuscript has been traced, and published in a

limited edition, with introduction, notes, etc., by Sr. A. G. Palencia (Madrid, 1921). Castellanos, then residing in Colombia, probably wrote his account in 1587, the year following the sack of Cartagena. He appears to have consulted all the sources open to him, especially eye-witnesses of the events narrated, and to have preserved a fair impartiality. He gives Drake a very good character but is, quite naturally, unable to refrain from habitually referring to him as a corsair, pirate, or "El astuto ladrón de Ingalaterra"; nor can he exclude religious animosity. In the appendices many documents bearing upon this period are printed, so that the whole work deserves to receive the attention of students.

THE STUDY OF NATURAL CALAMITIES

During the past few years, efforts have been made to promote international cooperation to relieve the victims of natural calamities such as floods and earthquakes. The first important step was the foundation in 1924 of a periodical, with the title *Materiaux pour l'étude des calamités*, by the Geneva Geographical Society in conjunction with the International Red Cross Committee and the League of Red Cross Societies. This periodical, from which we have already summarized several articles in this Record, is edited by M. Raoul Montandon. Recent articles have dealt with the periodicity of floods, the Mississippi floods, the distribution of the tsetse fly, and yellow fever. In July 1927 a Convention was held at Geneva under the auspices of the League of Nations, at which it was decided to form an international body to promote these objects—the *Union Internationale de Sécours*. By the beginning of 1928 seventeen states had signed the Convention establishing this Union. Its objects are declared to be the organization and coordination of immediate relief measures in calamities of exceptional gravity where the sources of the stricken people are inadequate, and the promotion in general of the study and prevention of such disasters. At the International Geographical Congress at Cambridge last year, a resolution approving the formation and aims of the Union was proposed by Comte G. E. Elia, vice-President of the Italian Geographical Society, and was carried unanimously. It noted with special interest that the Convention envisaged research into the occurrence of calamities, and asked for the cooperation of all geographers and historians, particularly in the preparation of an 'Atlas of Calamities,' the study of the laws controlling natural scourges and the collection of accurate scientific facts bearing upon them. Those interested in any branch of this extensive subject are invited to communicate direct with M. Montandon, rue de l'Athénée 2, Geneva.

CERCLE DES GÉOGRAPHES LIÉGEOIS

During the celebrations of the twenty-fifth anniversary of the School of Geography at Liége University in December 1927, it was decided to establish a geographical association in conjunction with the department. We have received recently the first number of the *Bulletin* of this body, detailing the preliminary steps in its formation. It is to be known as the *Cercle des Géographes Liégeois*, and its objects are the promotion of geographical science by research and publications, its popularization by public lectures, and the advancement of geographical education. Its close connection with the University is shown in its statutes, which limit effective membership to those connected, either as lecturers, graduates, or pupils, with the *Seminaire*. Indeed, it is plainly stated that the *Cercle* does not aim at becoming a 'Société de Géographie.' In addition to a *Bulletin*, a series of *Travaux géographiques* will be initiated, replacing the similar publication previously issued by the *Seminaire*, in which will be published theses offered for degrees in geography, and other original studies by members. The preliminary list of lectures show the centering of interest in

the development of Liége and its region. M. Joseph Halkin has been elected the first President, and the *Cercle* entered into full activity at the beginning of the year.

OBITUARY

ADMIRAL THE HON. SIR EDMUND R. FREMANTLE, G.C.V.O., G.C.B., C.M.G.

The death of Admiral Sir E. R. Fremantle removes from the world and the Geographical Society a venerable figure. He had been a Fellow for no less than sixty-six years. His active mind, eager to accept new conditions, enabled him to realize and assimilate the rapid changes that were taking place in his early youth and to see the advantages that their adoption would bring to the Service to which he was by tradition connected and to which he was himself deeply devoted. He saw service early, for at the age of sixteen he was engaged in the Burmese war, and though he says of himself that his early years were uneventful they afforded him opportunity of the practice of his profession afloat and abroad for long periods untrammelled by courses and classes. He was of those who were able to make use of regulations without being enslaved by them. Little need be said here of his professional career. It was the day of early promotion for those who could grasp opportunity, and Fremantle found himself a post-captain at the age of thirty-one.

If his career was not marked by any particular item of administrative reform or striking innovation he was ever ready to assist such effort. Similarly with the Society, we cannot record any marked contribution in Geographical Science, but his whole life was one of effort and encouragement, and we among others have greatly benefited by his long Fellowship.

One attribute is worthy of mention. He was able to concentrate his mind in a remarkable manner. It is recorded of him that on one occasion, seated on a chair of which the legs were uneven—the ship he was flying his flag in being aground at the moment—he sent for the carpenter and directed him to saw the legs of the chair even, continuing to write his despatches while the carpenter carried out his operation.

It amused him to say that his joining the R.G.S. was the only good financial investment he ever made, for he had compounded his Fellowship on joining.

W. E. G.

COLONEL R. C. HELLARD, C.B., R.E.

Colonel Robert Charles Hellard, whose death occurred on February 21, was born in 1851, being the son of Mr. C. B. Hellard, of Portsmouth. He was commissioned in the Royal Engineers in 1872 and served in the Egyptian Expedition of 1882, being present at the action of Kassassin. He was for many years employed on normal duties, and eventually served in Ireland as Officer in charge of the Irish Division of the Ordnance Survey. Many will remember the charming hospitality of Colonel and Mrs. Hellard in the delightful official residence, Mountjoy, in Phoenix Park, a house that had been the home of the Survey of Ireland ever since Colby's time in 1825. From Mountjoy Colonel Hellard was transferred to Southampton as Executive Officer of the Ordnance Survey, and after serving in this capacity very efficiently for some years, he was promoted to be Director-General of the Ordnance Survey in 1905. He held this post for three years, and one of the most important steps taken by him as Director was the excellent one of enlarging the size of the 1-inch sheets from 12×18 to 18×27 inches. In 1909 he was appointed to the London Traffic

Branch of the Board of Trade, and from 1912 to 1916 he was Superintendent of that Branch, and had much to do with the preparation of schemes for the relief of the rapidly growing traffic of the metropolis. He joined the Royal Geographical Society in 1905 and was a member of its Council for fourteen years, from 1908 to 1922, during part of which time he was a Vice-President. Whilst on the Council he took a great interest in the various schemes which were projected for the purchase of a new House for the Society, and Lord Curzon frequently consulted him on matters connected with the preparation of Lowther Lodge for occupation by the Society. During the last few years he had lived at West Malling, Kent, where his loss will be severely felt, as he had thrown himself heartily into local affairs, being a member of the committee of the British Legion there, and a Vice-President of the Malling Horse Show Society. He was always a popular man in the many capacities in which he served, a valued friend, and a judicious councillor.

C. F. C.

MEETINGS: SESSION 1928–1929

Ninth Evening Meeting, 4 March 1929. The President in the Chair

Elections: Tryphon A. Agelaston; H. Edmund Cooke, B.A.; Lt.-Commr. Archibald Day, R.N.; C. F. Hugo, M.A., B.EDUC.; Bartram Arthur Poole; David Edgar Price, B.SC.; Edward Boys Reed; Charles Hubert Reynolds, M.INST.C.E.; Miss Alice G. Tasker; Harry S. Thomas

Paper: The Kalambo Falls, Northern Rhodesia. By Mrs. Gordon-Gallien, Mr. J. W. Cornwall, R.A., and Mr. Colin C. Rose

Fifth Afternoon Meeting, 11 March 1929. The President in the Chair

Paper: Echo Sounding. By Rear-Admiral H. P. Douglas

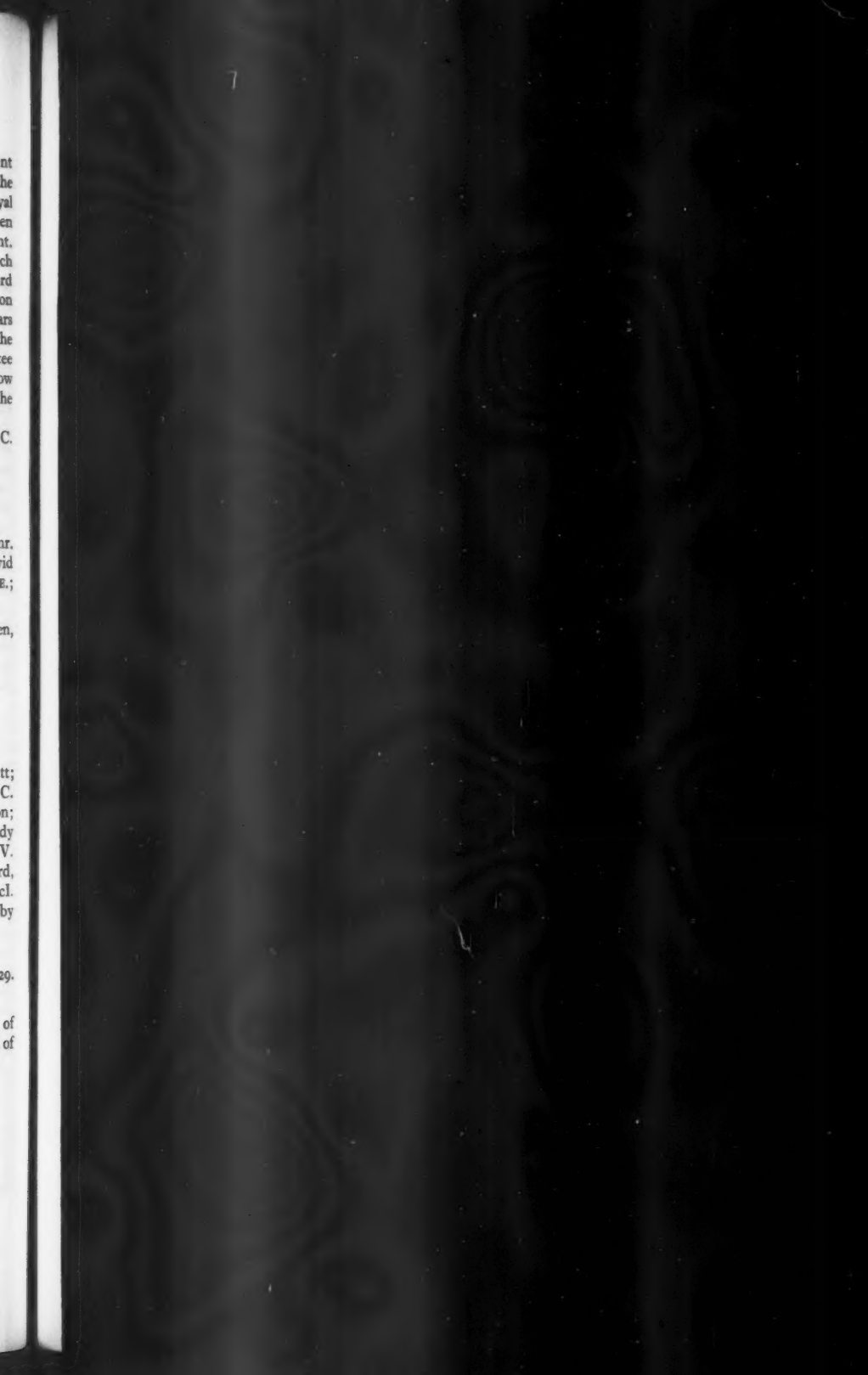
Tenth Evening Meeting, 18 March 1929. The President in the Chair

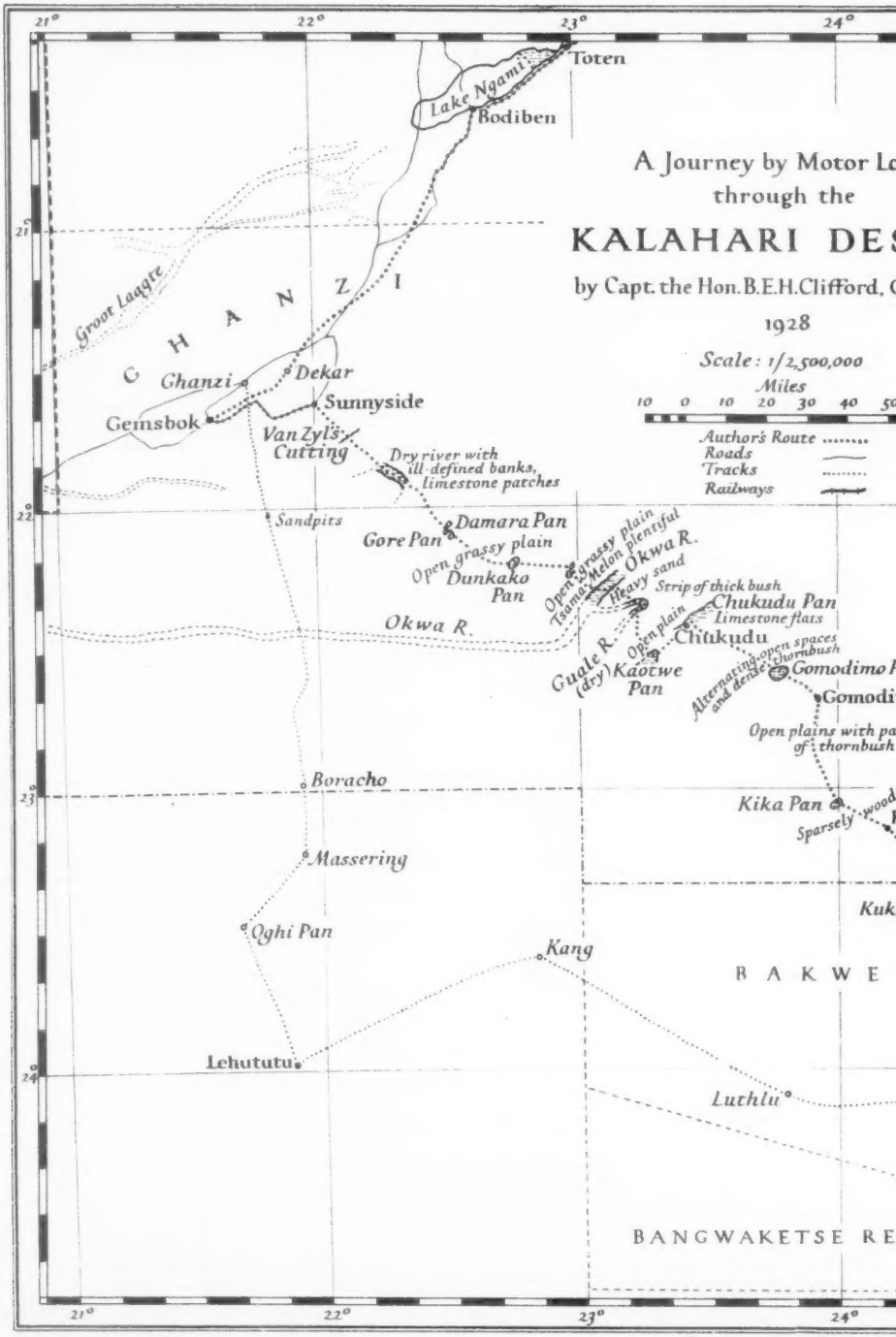
Elections: Tarin Henry Dias Aheyagunawardena; Cecil Austyn Bartlett; G. W. Basil Boyer, M.A.; Adrian Brunel; Maurice Done Bushell; Lieut. G. C. Clark; Prof. George B. Cressey, PH.D.; Capt. Cornelius Albert Edwin Deacon; Miss Edith Mary Gray; Percy Wyn Harris; The Rev. James Hayes; Lady Heath; Mrs. Mary Idris; Dr. Douglas W. Johnson; P. H. Lacon; Gordon V. Lewis; Lady Manners; John Mathewson; F. B. Sadler; K. S. Sandford, D.PH., F.G.S.; W. P. Skelton; Capt. Garth Newbon Trace, D.F.C.; R. McI. Tyndale-Biscoe; W. H. A. Webster, C.I.E.; Dr. Jonathan M. Ferdinand Whitby

Paper: Air photographs of the Middle East. By Mr. O. G. S. Crawford

Special Evening Meeting, Regent Street Polytechnic, 25 March 1929. Admiral Sir William Goodenough (Vice-President) in the Chair

Sir Douglas Mawson gave an account of recent work in the fiords of Southern New Zealand, and showed pictures and films illustrating the work of the Australasian Antarctic Expedition, 1911–14.




A Journey by Motor La
through the
KALAHARI DES
by Capt. the Hon. B.E.H. Clifford, C
1928
Scale: 1/2,500,000
Miles
10 0 10 20 30 40 50
Author's Route
Roads
Tracks
Railways
21°
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24°
Toten
Lake Ngami
Bodiben
Groot Laagte
CHANZI
Ghanzi
Dekar
Sunnyside
Gemsbok
Van Zyl's Cutting
Dry river with ill-defined banks, limestone patches
Sandpits
Damara Pan
Gore Pan
Open, grassy plain
Dunkako Pan
Open, grassy plain
Tsama-Melon plentiful
Okwa R.
Heavy sand
Strip of thick bush
Chukudu Pan
Limestone flats
Okwa R.
Open plain
Chukudu
Guale R. (dry)
Kaotwe Pan
Alternating open spaces and dense thornbush
Gomodimo
Gomodi
Open plains with pa
of thornbush
Boracho
Kika Pan
Sparsely wood
Massering
Kuk
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BAKWE
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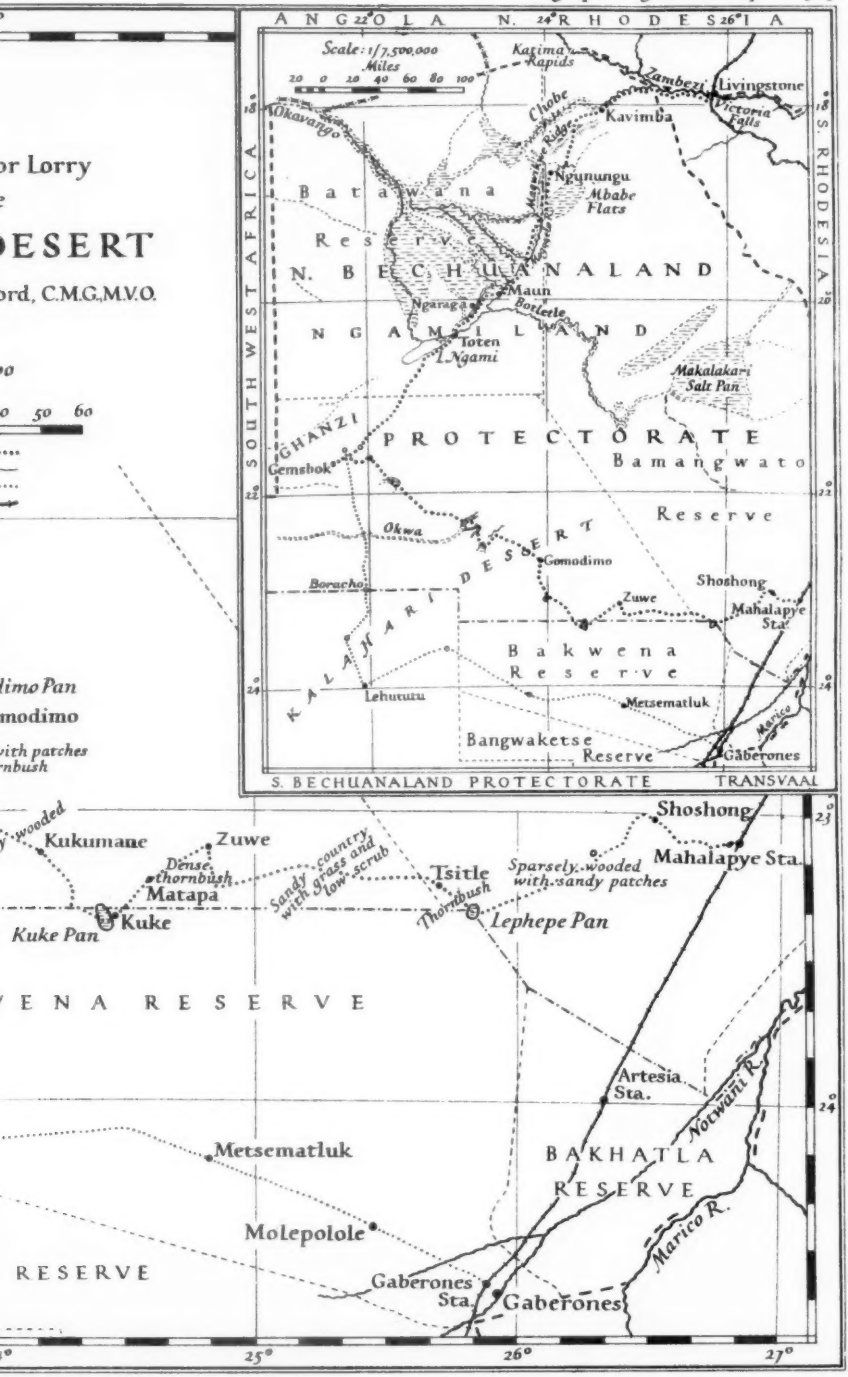

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KALAHARI DESERT
Clifford